FEBRUARY 1, 1930

ELECTRICAL WORLD

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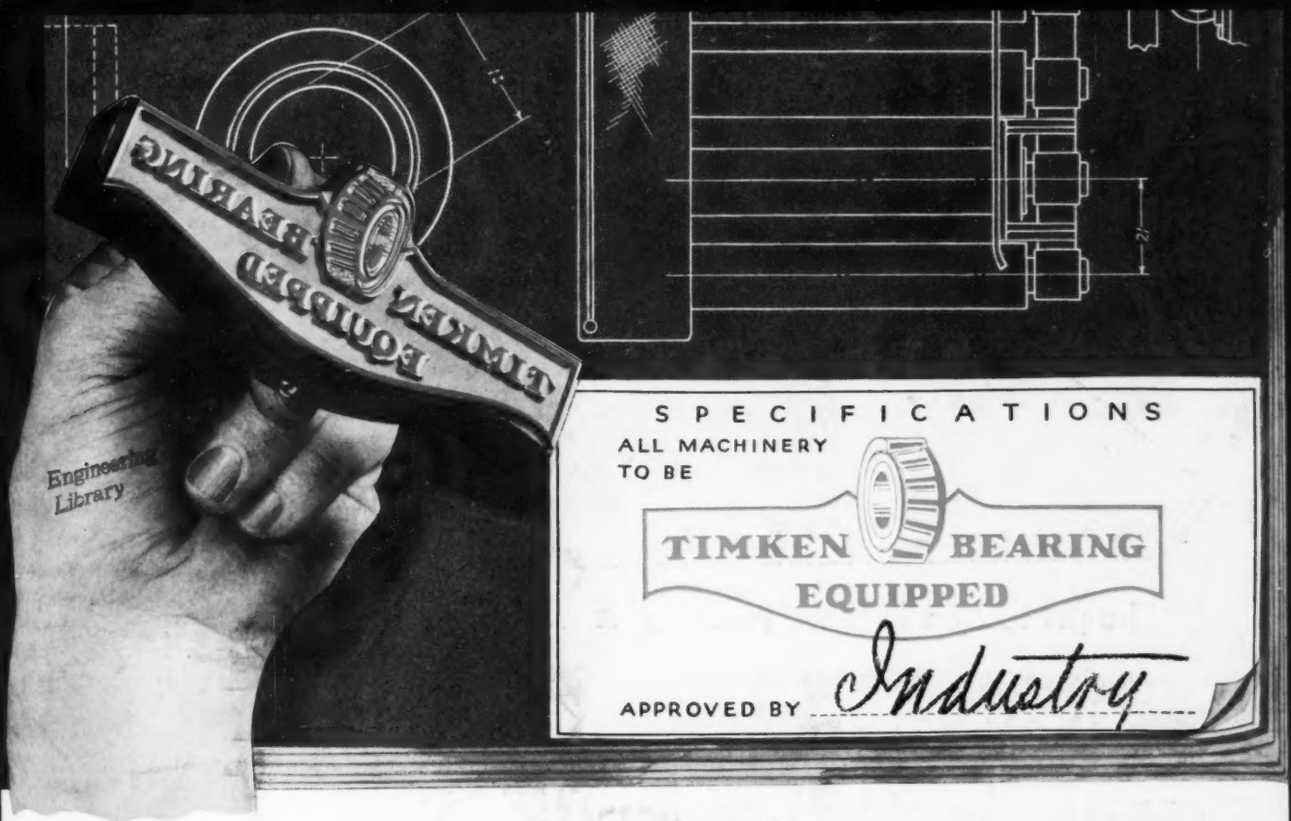

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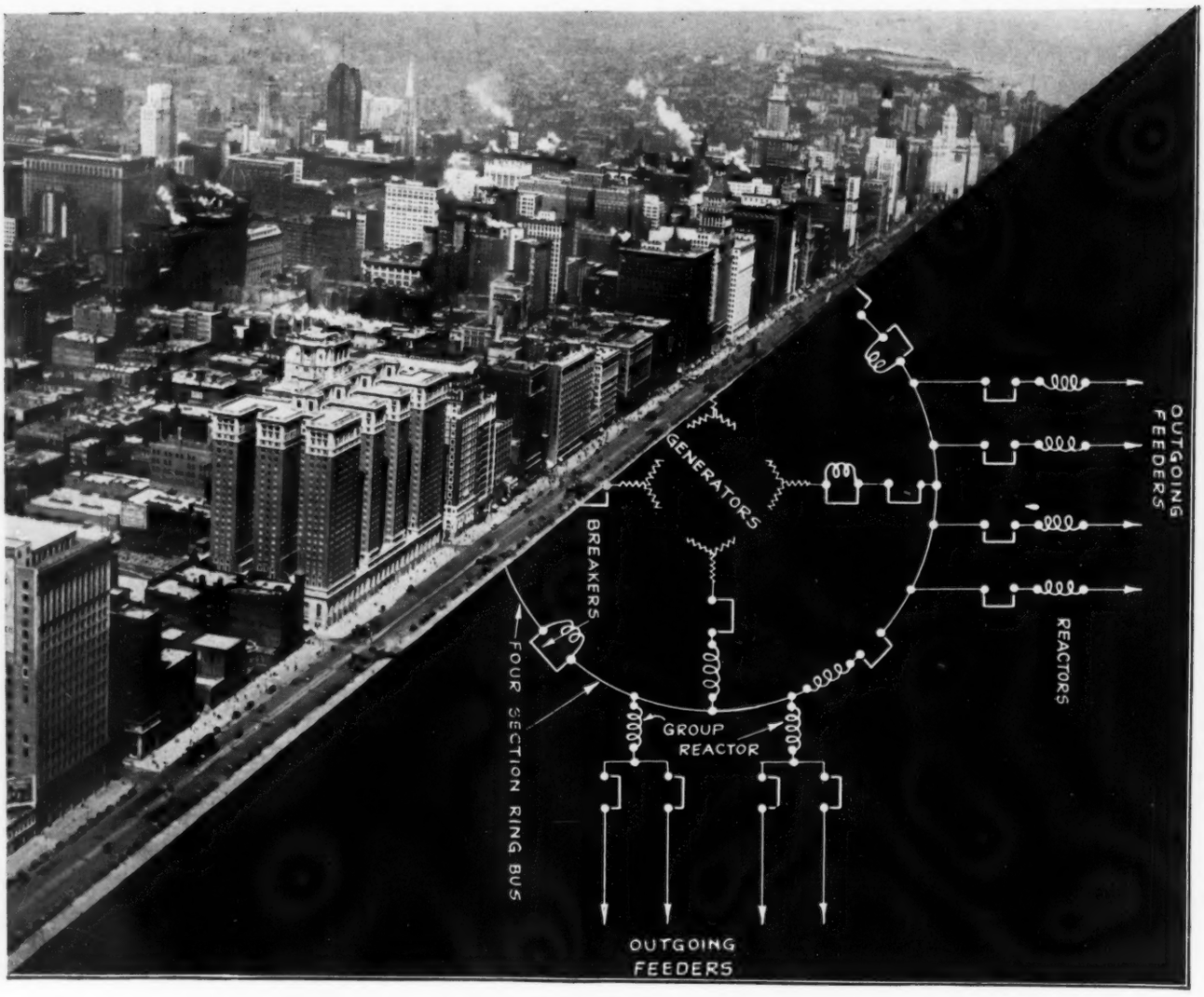

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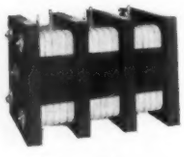

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Chicago
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Boston
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Pacific Coast Editor
883 Mission St.
San Francisco
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Washington
Correspondent
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JAMES H. RUDD
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ELECTRICAL WORLD

for the Week Ending

February 1, 1930

Comment On the News

TELEPHONE RATES in New York State and City have been increased. This has renewed agitation to prevent utility companies from taking rate cases to federal courts until the facilities of state courts are exhausted. Another controversy about state rights is thus started.

CONVENTION NEWS of the A. I. E. E. winter technical gathering now occupies much space in the metropolitan dailies and not infrequently "makes the first page." Proof surely that the Institute's deliberations are no longer thought of by laymen as incomprehensible excursions into pure science but are seen by intelligent readers to have an intimate connection with every-day life as it is and as it will be.

HYDRO-ELECTRICITY AND NITRATES are firmly wedded in many minds. Nevada's water commissioner wants Secretary Wilbur to turn down the bids received from California for Boulder Dam power and sell the entire output to Nevada at 1.75 cents instead of 1.63 cents a kilowatt-hour. He dwells on transmission-line losses and thinks that California industries would profit more by the electrochemical materials which Nevada would proceed to have manufactured in unlimited quantity than by the unconverted energy. Loud cheers from Los Angeles have not yet been heard.

SOUND THOUGHT on the utility business is contained in an article by Martin J. Insull in the current *Forum*. He combats the utility philosophy of Governor Roosevelt of New York by a straightforward exposition of actual conditions in finance, regulation and operation. No one will dispute that Mr. Insull knows the business and writes with understanding and thought as a background.

ENGINEERING AND INDUSTRIAL assemblages constantly give evidence in the thoughts for which they afford opportunity of expression that in both financial and commercial fields the trained technical man can find large opportunities. Michigan engineers were told on Thursday by the president of the Electric Bond & Share Company that the engineer can, and in any sound undertaking in some sense must, bring his direct engineering experience to the aid of the financier who assembles the capital.

NEWS OF THE WEEK

A. I. E. E. Members Hear the Story of Engineering Progress

ADVANCES in technique to improve electric service in many applications provided many and varied topics for the winter convention of the American Institute of Electrical Engineers, held this week in New York City. Better lightning protection, power-system planning, welding, overseas telephony, dielectric research, machinery design and ultraviolet radiation "high-lighted" the program. The papers and discussions revealed the fruits of continuous hard work by enthusiastic specialists seeking always to provide better equipment and operating methods for the benefit of the art and disclosed the value of mass attack upon the complex problems which simultaneously beset and delight the professional electrical engineer. Well-planned inspection trips to outstanding installations in the metropolitan area brought many members into close contact with the latest material progress in applied electricity. Many pleasurable features were embodied in the entertainment and social side of the convention.

Improvements in lightning-arrester design occupied much attention at the opening session on Monday afternoon. Circuit-breaker practice also came in for basic treatment as affected by developments in the Deion grid. Evidence that power system planning bids fair to become a routine branch of central-station practice was voluminous at the Tuesday morning session.

Intense interest in the protection of power systems against lightning culminated in a special session on Wednesday devoted to special investigations in this field. The fighting line of the engineer has moved from his laboratory base into the open, and eight papers and their discussion gave proof of the value of continuing field researches on a much larger scale and with multiplied observation points.

Transoceanic telephony and telegraphy were shown to have attained notable improvement in reliability in a session on Thursday upon overseas communication, and the extension of radio and telephone cable service now under way marks an inspiring advance in this specialized field. Strides made by arc welding, dielectric research prosecuted to insure greater reliability of cable operation in the power field, and forward steps in electrophysico-mathematical inquiries and in machinery design were related in the closing sessions.

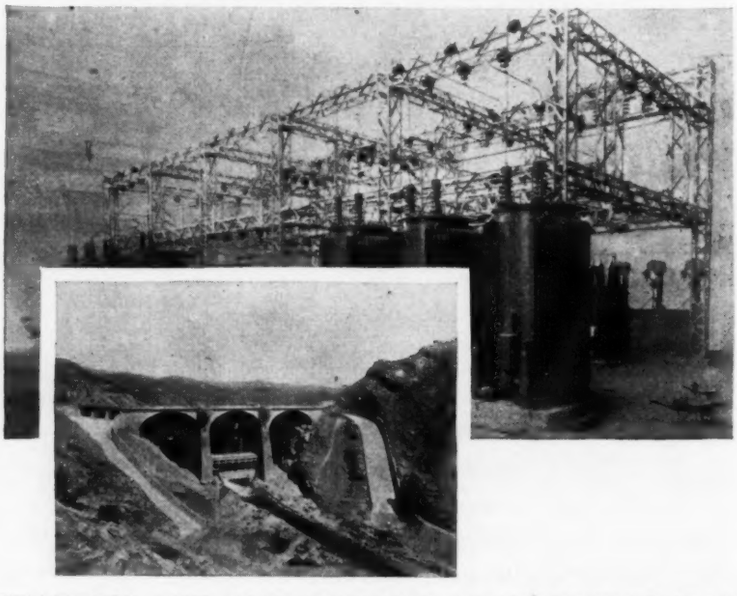
Presentation of the Edison medal to Prof. C. F. Scott of Yale on Wednesday evening is referred to on page 252. Announcement was also made that the Lamme medal had been awarded to Rudolph E. Hellmund, chief electrical engineer of the Westinghouse Electric & Manufacturing Company. This medal will probably be presented at the June convention in Toronto. A detailed report of the meetings will be printed next week.

▼

Groesbeck Extols Engineers at Ann Arbor

THE engineer and the financier, working together, have been able to create the machinery of production and distribution which has permitted the people of the United States to assume leadership among the industrial nations of the world, C. E. Groesbeck, president of the Electric Bond & Share Company, New York, declared at the opening session of the two-day meeting of the fourth engineering conference at Ann Arbor, Mich., on Thursday, January 30. About 750 engineers were in attendance at the conference, which is celebrating the fiftieth anniversary of the founding of the Michigan Engineering Society. Twenty-eight engineering societies participated.

"Unless I misread all the signs of the



STATION AND SUBSTATION AT COOLIDGE DAM

The power house has been cleverly worked into the base of the center arch of the Coolidge irrigation dam in Arizona, the substation being built under the dome of this arch and back of the power station itself. The Westinghouse company installed the equipment, the International Derrick & Equipment Company erecting the substation

times," Mr. Groesbeck said, "the contribution which the engineer has made in the field of finance during the past fifty years is as nothing to the contribution he will be called upon to make during the next half century." In this mechanized world, he went on, requiring continual outlays of new capital, engineers are being called upon to assume and justify responsibility for expenditures which make possible the functioning of the entire industrial system.

▼

Congressional Activities with Electrical Interest

SHARP criticism of the recent Interior Department ruling on the sale of power from Boulder Dam was made on the Senate floor on Tuesday of this week by Senator Norris of Nebraska. According to Solicitor Finney's advice to Secretary Wilbur, the financial requirements for power contracts are to be placed on such a basis that cities and other public entities may have to wait some time for legislative action and the floating of bond issues before they are able to comply. Thus it was contended that the West Coast "power trust" would be able to rob them of their just due. In part support of Senator Norris Senator Johnson of California agreed that the bill could not have passed without the proviso favoring municipalities.

Action on the bill providing for the acquiring of land for park purposes in the Great Falls sector of the Potomac probably will have been taken by the House of Representatives before this is printed. Objection was raised to the bill, which is being urged by Representative Cramton of Michigan, on the ground that it would preclude the development of power, navigation and flood-control plans on the Potomac. It was argued that legislation should await a report on a survey of the river now being made by the army engineers. An amendment to the bill proposed by Representative Dempsey, the chairman of the committee on rivers and harbors, provides that the acquisition of any land in the Potomac River Valley for park purposes shall not debar or limit or abridge its use for such works as Congress may in the future authorize. Representative Cramton attacked "certain power interests" for alleged lobbying against this bill, naming in particular the Byllesby power group.

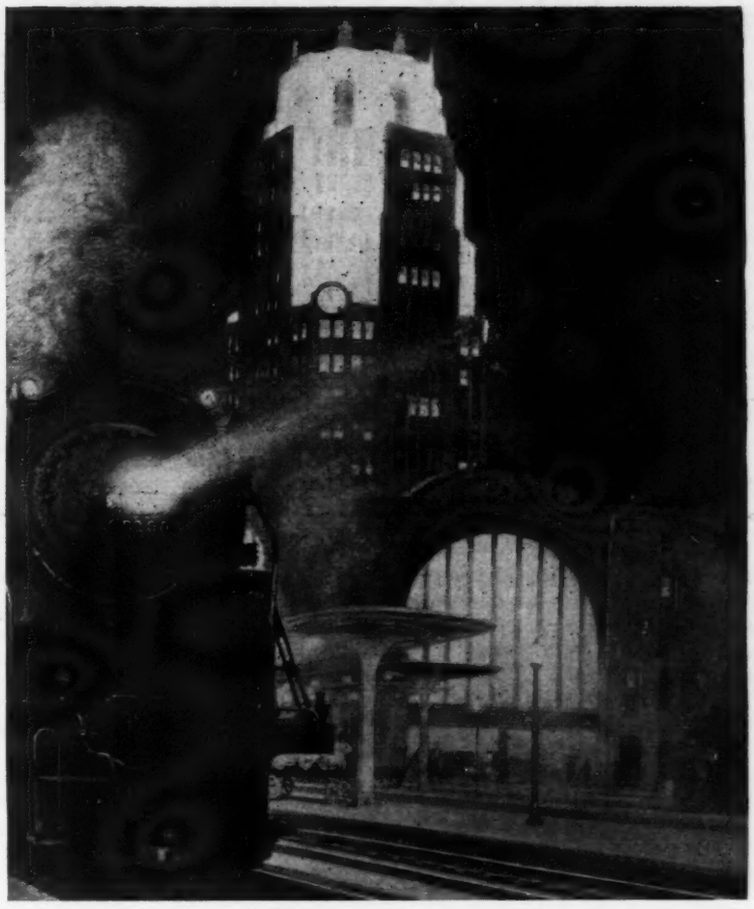
Preparatory to framing a bill for a new government set-up in the control of communications, the interstate commerce committee of the Senate to complete its hearings, the last one being scheduled for about February 5, after which two or three weeks will be spent in drafting legislation. Soon afterward it is expected that the power phase of the investigation will begin. By that time questionnaire data on interstate sale of power will be made available by the Federal Trade Commission. It is to be assumed that Senator Couzens' committee will avoid duplication of the Trade Commission's investigation in shaping its hearings and will take advantage of the testimony offered before the trade body.

A bill providing for the reorganization of the Federal Power Commission has been introduced by Representative Celler of New York. As Mr. Celler is a Democrat, the bill cannot be regarded as the administration measure intended to put into effect the recommendation of the President in his message to Congress. It provides that the President shall appoint three commissioners, to be approved by the Senate. They will appoint a secretary, chief engineer and chief auditor. During their terms of office the commissioners are not to have other employment. The appointment is for a period of seven years and the salary $10,000, with $2,500 extra for the chairman. One of the commissioners must be of the minority political party.

The sixth conference of the water-power policies committee of the United States Chamber of Commerce was held in Washington on January 20, 21 and 22. The committee's factual studies are finished and the final report is nearly completed. An intensive study of the Muscle Shoals situation will be a feature of the report.

A resolution directing the Federal Power Commission not to issue or approve any permits or licenses on the Columbia River at or above the Grand Coulee dam site pending the forthcoming report of the Engineer Corps as to the use of this stretch of river was offered on January 27 by Senator Dill.

WHERE ELECTRICITY LOOKS AT STEAM



A difficult job in colored floodlighting was recently completed at Buffalo, the new terminal station of the New York Central Railroad being the structure. A total connected load of 48 kw. serves 250-watt and 500-watt lamps and projectors which are set in the niches of the building. When this road is electrified from New York to Buffalo the steam locomotive will fade from the picture.

Increased New York Telephone Rates Stir up Much Political Agitation

NOTIFICATION from the New York Telephone Company to its customers in Greater New York and elsewhere of a considerable advance in rates, to take effect February 1, led this week to the unanimous passage at Albany of a resolution memorializing Congress to give to state courts exclusive jurisdiction in utility rate appeals in commonwealths where there is a regulatory body. Such bills have just been introduced by Senator Wagner and Representative Somers of New York and by other members of Congress. Similar bills have been introduced in former Congresses, but have never got very far. They do not, of course, aim to prevent appeal from the highest court of a state to the United States Supreme Court on a constitutional issue. How much impetus the support of the largest state in the Union will give at Washington to the proposed statutory restriction on litigation remains to be seen.

Governor Roosevelt of New York is in favor of the legislative resolution and will undoubtedly forward it to Congress. He said in a special message to the Legislature:

> Time and again we have seen utility companies rush in to the federal courts to obtain injunctions against state commissions. Although state courts are open to them, they have refused to accept state tribunals, but instead have sought the aid of federal judges. I consider such action to be contrary to sound theories of government and an improper encroachment upon state home rule. The control of local rates is a matter of purely state concern. The acts of state boards and commissions should be subject in the first instance to review only by state judicial tribunals.
>
> No one can object to an orderly appeal by the telephone or other utility company to the United States Supreme Court after the State Court of Appeals has passed upon the question. But the system of two concurrent original jurisdictions from which the public utility may at will choose its forum is contrary to our sense of orderly administration of justice as well as our concept of local self-rule and self-government.
>
> The people of our state are more and more resentful of the assumption and retention of jurisdiction by federal judges. We have had many examples in electricity, gas, telephone and subway cases. It means that hearings and trials which rightfully should be held before our Public Service Commission or before state courts are, by a scratch of the pen, transferred to a special master appointed by the federal court. The state regulatory body, set up by our law to inquire into matters of valuation, depreciation, operating expenses and other factors entering into rate making, is laughed at by the utility seeking refuge with a special master, who is unequipped by experience and training, as well as by staff and assistants, to pursue that searching inquiry into the claims of the company which the consuming public is entitled to demand. The special master becomes the rate maker; the Public Service Commission becomes a mere legal fantasy.

Under the provisions of another bill, introduced by Senator Buckley, the corporate existence of the New York Telephone Company would be dissolved on the ground that it has refused to cooperate with the established rate-making agencies or to seek legal redress for any alleged wrongs through the established agencies and courts in the State of New York and is now attempting to force the people of the state to pay a higher rate than hitherto charged.

Governor Roosevelt also sent a letter to the Public Service Commission urging strongly that the telephone increase be halted. The New York Telephone Company submitted its new rates to the commission, but did not "file" them in the legal sense, thus preventing their suspension. The regulatory body met on Tuesday, municipal officials from all over the state being present. The commission was deliberating behind closed doors at the time the ELECTRICAL WORLD went to press. It was predicted by some observers that it would substitute for the company's new rates rates of its own arrived at by a reduction of the amount which the company added to the valuation after the court decision to cover subsequent capital expenditures. The power of the commission to take this course was admitted by counsel for the telephone company. Of course, if the commission should decide to do this, the company could again appeal to the United States courts for redress.

Here is a brief statement of what has brought about the situation:

Appealing from the commission's valuation and prescribed rates, the New York Telephone Company went to a United States court asking an 8 per cent return on $727,000,000. A special master appointed by the court cut that valuation to $518,109,584. The federal court cut it further to $397,207,295 and lowered the rate of return to 7 per cent. This reduced the proposed increase in revenue from the $21,578,078 recommended by the special master to $7,933,866.

So far the company's customers had the better of it; but this valuation was as of July 1, 1928, and the company, without consulting the commission, has added to it $133,000,000 for alleged actual and estimated capital expenditures from that date to July 1, 1930. The justification for this increase in valuation is the question now before the commission, the federal court's figures being, of course, subject to review only by the United States Supreme Court, to which the finding of the lower federal court can be appealed.

PUBLIC SERVICE OF NORTHERN ILLINOIS BUYS AIRPLANE

When the "Northern Light," a Sikorsky amphibian plane recently purchased by the Public Service Company of Northern Illinois, was delivered at Chicago it was welcomed by an impressive delegation from that company, including Vice-Presidents John G. Learned, George R. Jones and Julius L. Hecht and Chief Engineer C. G. Bennett. Arthur Caperton is the pilot.

Electrical Engineers Visit President

Wide World

PRESIDENT HOOVER greeted many fellow engineers during a meeting last week of the undergrounds system committee of the National Engineering Section, N.E.L.A., at Washington. Chairman G. B. McCabe of the Detroit Edison Company is on his right and H. W. Clark of the Potomac Electric Power Company, Washington, on his left.

Among those "also present" may be seen Vice-Chairman C. T. Sinclair, of the Byllesby organization at Pittsburgh; Secretary L. F. Hickernell, of Stevens & Wood, Jackson, Mich.; R. L. Dodd, Milwaukee Electric Railway & Light Company; R. G. Walter, Wisconsin Power & Light Company, Madison; Arthur A. Meyer, Detroit Edison Company; R. W. Atkinson, Standard Underground Cable Company, Perth Amboy, N. J.; C. A. Mayo, Malden (Mass.) Electric Company; T. F. Peterson, American Steel & Wire Company, New York; W. H. Cole, Boston Edison company, and A. S. Kirk, Blackstone Valley Gas & Electric Company, Woonsocket, R. I.

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Nevada Wants Dam Power for Electrochemical Use

NEVADA projected a new bone of contention into the Boulder Dam argument when at last week's conference of the three Lower Colorado Basin states at Reno her representatives offered to take over the full amount of electrical power at Boulder Dam at a price above that proposed by Secretary of the Interior Wilbur. Secretary Wilbur has proposed to sell the power at the dam for 1.63 mills a kilowatt-hour, while the Nevada offer would bring the government 1.75 mills. The larger offer would produce about $400,000 more annually than the Wilbur price, or $20,000,000 over a period of 50 years.

The water commissioners of Colorado and New Mexico—Delph E. Carpenter and Francis C. Wilson—have come to the support of the Nevada plan, put forward by George W. Malone, water commissioner of the last-named state.

Electrochemical development is the purpose behind the scheme, and its proponents declare that in this, rather than in transmitting power to California with heavy transmission losses, lies the proper economic use of Boulder Dam energy.

▼

Ontario and Quebec Near Agreement on Carillon Site

FROM a preliminary power conference held in Ottawa on January 24 between representatives of the Dominion, the Ontario and the Quebec governments came an announcement by Premier Ferguson of Ontario that an agreement had been almost concluded between his province, on the one hand, and the Province of Quebec and a private company for the development of 200,000 hp. at Carillon, on the Ottawa River about half way between Ottawa and Montreal.

Premier Ferguson pointed out that the two provinces were now in agreement as to the general provisions of the pact, and that as for the actual physical structures necessary for the joint development of the power, arrangements would be made between the Ontario Hydro-Electric Power Commission and the National Hydro-Electric Company, the holder of the small lease which was granted in 1911 and which is not terminable until 1974 and which is understood to be really controlled by the Shawinigan Power interests.

The conference between the representatives of the Dominion and the provinces was held in private and no important information was given out as to the results.

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Northwest Properties to Be Consolidated

EARLY purchase of the Kootenai Power Company and the Lewiston-Grangeville district property of the Inland Power & Light Company by the Washington Water Power Company is announced. The conjectural price is around $5,000,000. The Kootenai company serves part of the Cœur d'Alene region in Idaho. The Inland Power & Light, which, like the Washington Water Power Company, is controlled by the American Power & Light, has headquarters at Portland, Ore.

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State Line to Add 275,000 Kw. in Two Units

PLANS for enlargement of the State Line Generating Company's generating station on the shore of Lake Michigan at the Indiana-Illinois State Line are announced. Two new turbo-generators have been ordered which will increase the capacity of the station to 483,000 kw. One of these units, rated at 150,000 kw. at 90 per cent power factor, will be built by the General Electric Company at Schenectady. The other, of 125,000 kw. capacity at 85 per cent power factor, will be built by the Allis-Chalmers Manufacturing Company of Milwaukee.

These two turbines will compose the second section of the State Line station. They will be operated at 1,200 lb. steam pressure, which will be the highest steam pressure used in an electric generating station in the Chicago district. The addition, which will take about two years to complete, will make the State Line station the second largest generating station in that district. Contract has been placed with the Babcock & Wilcox Company for the boiler equipment for the two new generating units.

ELECTRIFICATION OF PALESTINE GOES ON

International News Reel

Electrification of Palestine goes on slowly. A dam is now being built across the Yarmuk, at the site shown above. It will be of the same height—25 ft.—as that started a year or more ago on the Jordan, where a 24,000-hp. plant is planned. The Yarmuk is a tributary of the more famous river.

Scenery Versus Power an Issue in Virginia

VIRGINIA'S Supreme Court of Appeals has confirmed the State Corporation Commission's decision that the latter has no authority to grant the Virginia Public Service Company a license to construct a dam across the North River at Goshen Pass. Construction of the dam was opposed by the Garden Club of Virginia and others on the plea of scenery conservation. The company is still free to ask the courts for the right of eminent domain if it desires to do so.

▼

Iowa Company Obtains Franchise in Saskatchewan

MOOSE JAW, Saskatchewan, has decided to sell its municipal light and power plant to the Iowa Southern Utilities Company and to grant to that company an exclusive franchise to operate the utility for 20 years. The price offered by the company was $2,875,500 in cash with a sum of $150,000 as a fund to be administered with a view to securing the location of industries in the city, which, with about 20,000 population, is one of the three largest in this prairie province. Regina, with 35,000 people, and Saskatoon, with 26,000, are both served by municipal plants.

▼

Strife in Los Angeles Over Annexed Territory

HEARINGS have begun before a member of the California Railroad Commission in the matter of the city of Los Angeles' determination to acquire properties of the Southern California Edison Company in territories recently annexed to the city. The hearing is a part of a condemnation action begun by the city and is expected to result in the commission fixing a price for the properties, involving power lines and substations in twelve annexed territories.

This is the second condemnation suit over Edison properties to be filed by Los Angeles since the city's Bureau of Power and Light took over the Edison company's system by purchase in Los Angeles proper in 1922. The United States Supreme Court on January 20 dismissed an appeal of the Edison company from a decision rendered in the first suit by the California State Supreme Court, which upheld the right of the city to condemn Edison properties for $865,000. This suit, begun in 1925, involved properties in 26 annexed territories. The utility demanded $3,166,960 for the properties, whereas the Railroad Commission fixed the price at $865,000.

▼

Optimism Manifest at St. Paul N.C.E.A. Meeting

WIDESPREAD expansion in the electrical industry in 1930 was the theme of C. E. Greenwood, commercial director of the N.E.L.A., at the commercial session of the North Central Electric Association held in St. Paul last week, 150 sales representatives of light and power companies being in attendance. An outline of the commercial situation was presented by Fred Hoffman, chairman, and "New Developments" was the subject discussed by John Lapham, secretary-manager of the geographic association. Round-table discussions and informative speeches by well-known electrical men filled out a well-arranged two-day program.

▼

Commonwealth Edison Breaks Some Records

REPORTS of the engineers of the Commonwealth Edison Company, just issued, show that in 1929 the company established a new high record for output of electrical energy. The total output of energy produced and purchased was 4,276,181,000 kw.-hr., as compared with 3,851,106,000 kw.-hr. in 1928. The increase was as great as the company's annual output twenty years ago, the engineers say.

The company's Crawford Avenue station in December broke several records, including th world record for output of a single station. With an installed capacity of 425,000 kw. and an absolute maximum of 406,300 kw., the average daily demand was 300,830 kw. and the total output for the month was 206,452,440 kw.-hr. The operating load factor for the month was 76.9 per cent and the capacity factor 65.5 per cent. The B.t.u. per pound of coal was 10,715, and the B.t.u. for each kilowatt-hour sent out was 14,723. The amount of coal burned for each kilowatt-hour sent

out was 1.37 lb. The net output of the Crawford Avenue station for the year was 2,006,768,800 kw.-hr., which was 43 per cent of the company's total output and nearly equal to the entire output of the company in 1922.

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Southern Sierras Company Need Not Reduce Rates

AS ANTICIPATED in the ELECTRICAL WORLD for last week, the California Railroad Commission has issued an order rescinding its order fixing rates for the Southern Sierras Power Company, which would have resulted in a reduction to consumers of approximately $300,000 a year. Findings of the United States Supreme Court in the case of the United Railways & Electric Company of Baltimore to the effect that the present value of utility properties, and not their original cost, should be used as a basis for figuring depreciation overthrew the foundation on which the California commission had based its order.

▼

Permits Asked on Alleghany and Current Rivers

APPLICATION has been made to the Federal Power Commission by the West Penn Power Company of Pittsburgh for a preliminary permit covering a proposed development at the United States Dam No. 8 on the Alleghany River. This dam is now under construction. At this dam 4,000 hp. of primary power will be available. It is proposed, however, to install equipment sufficient to generate 31,000 hp.

The Missouri Electric Power Company of Chicago has applied for a preliminary permit for a project on the Current River in Carter County, Mo. It is proposed to construct a dam 50 ft. high and 1,000 ft. long near Doniphan and to install 20,000 hp.

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Railway Plant Yields to Central-Station Service

TO SERVE the Boston & Worcester interurban railway under a power contract recently made with the Boston Edison Company it was arranged to provide 60-cycle energy in place of the 25-cycle energy transmitted for the past 28 years from the railway company's steam plant in Framingham to the substations of the trolley road. Sixty-cycle rotaries from the substations of another traction company whose cars were run by Edison power prior to the installation of buses were transferred to the interurban road, which is expected to draw about 3,000,000 kw.-hr. a year from the Edison 13,800-volt lines.

In this way the capital cost of serving the interurban was materially reduced. The Framingham steam plant, containing a 2,000-kw. vertical turbine unit and two compound-engine-driven generators of 500-kw. and 1,000-kw. rating, now passes out of the picture after many years' service.

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Kansas Court Says Voters Must Pass on Franchise

THE right of municipal electors to have a final voice in the granting of public utility franchises was upheld by the Kansas Supreme Court on January 13, when an ordinance passed by the City Commission of Manhattan granting a franchise to the United Power & Light Corporation was held void. The court's decision was handed down in proceedings filed by the municipality to test the validity of the franchise, which the city contended was nullified by an adverse vote at a referendum subsequent to its passage by the City Commission.

On July 3, 1929, a petition containing the franchise ordinance was presented to the City Commission by the required number of voters, requesting that the ordinance be submitted to a vote of the people if not passed by the commission. The ordinance was passed by the latter by a two-thirds majority. Subsequently another petition asking a popular vote was filed, and the referendum election followed, resulting in the eleven-year franchise being defeated by 1,333 to 967. The company's old franchise expired September, 23, 1928.

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Columbia River Project Authorized by Government

A LICENSE for the immediate construction of the dam and power project of the Washington Electric Company on the Columbia River was issued on January 21 by the Federal Power Commission. This project was described in the ELECTRICAL WORLD for January 11 (page 83). Initial capacity will be 80,000 hp.

The project is of unusual interest since it will be the first step in the

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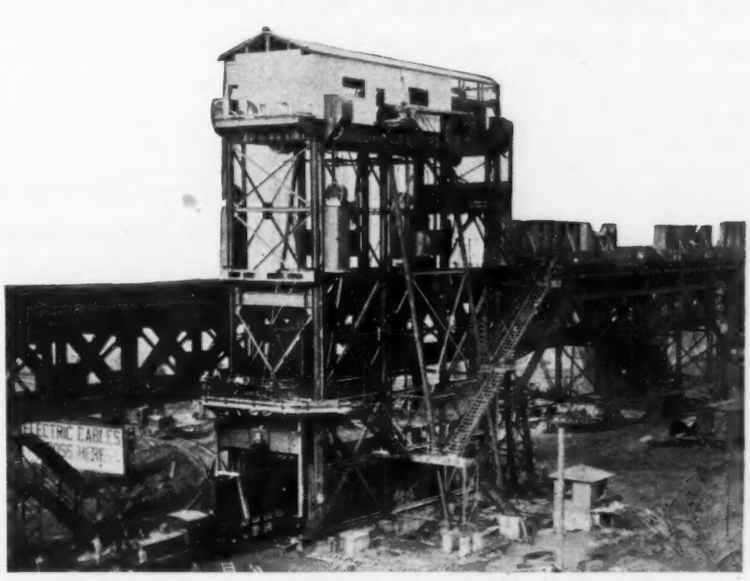
ELECTRIC CAR HOIST ON BRUNOT ISLAND



TO CONVEY material shipped by rail over elevated main-line railroad tracks to the James H. Reed generating station now in course of erection on Brunot Island, Pittsburgh, the Duquesne Light Company utilizes a freight-car hoist designed and built, in a shaft provided by the power company, by the Wellman-Seaver-Morgan company of Cleveland. This hoist, which lowers and raises cars to and from the power company's track on the ground 50 ft. below an elevated siding, has a rated capacity of 200 tons exclusive of the lifted apparatus. It is operated on 440-volt, three-phase current.

REJUVENATING A VETERAN SIGN

One-half mile from and 470 ft. above the Bluefield (W. Va.) railroad station, this 140-ft. x 70-ft. sign has attracted notice for seventeen years. Recently, however, more lamps and larger ones have added materially to its brilliancy.

harnessing of the vast latent power resources of the Columbia River—one of the most important in the country. Estimates indicate that approximately 2,000,000 hp. could be generated at various feasible sites on this river within the State of Washington alone. Controversial questions raised by conflicting interests, involving the safeguarding of navigation, protection of commercial fishing by means of fishways and protection of the rights of the upper basin states, Montana and Idaho, have, the Federal Power Commission says, been solved as the result of months of study by its agents.

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San Joaquin Corporation to Build 35,000-Kva. Plant

BUILDING of a 35,000-kva. steam generating plant at an estimated cost of $3,500,000 by the San Joaquin Light & Power Corporation, Fresno, Calif., is announced by A. Emory Wishon, vice-president and general manager. Work will start by March 1, and the schedule calls for completion of the project by June, 1931. The plant will be of the single-unit type, housed in modern steel and concrete buildings. Natural gas will be used as fuel, although the boilers also will be equipped to burn oil if necessary.

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Nebraska Commission May Take Larger Jurisdiction

STRONG disinclination is expressed by the Nebraska Railway Commission to follow the advice of Attorney-General Sorensen that it assume jurisdiction over rural electric rates and also rates for service outside the incorporated cities and villages of the state. Such jurisdiction, the Attorney-General recently held, was given the commission by a new law. Chairman J. E. Curtiss, in an authorized interview, says that the author of the bill consulted with members of the commission before introducing it and that his sole object was to protect the farmer or suburbanite who was restricted in his choice to one power company. Mr. Curtiss said that the intention of the Legislature was also to be judged from the fact that it made no appropriations to cover the expense of valuations.

George A. Lee, general counsel for the Iowa-Nebraska Light & Power Company, has addressed a letter to the commission saying that his company would welcome its assumption of jurisdiction and suggesting that it hold hearings and conferences in order to work out a concrete program that would include standard schedules and standard contracts.

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Tacoma and Seattle See Need for Steam Reserves

PLANS for a two-million-dollar steam generating plant to be built by the municipal lighting and power department of the city of Tacoma, Wash., are being completed by engineers of the lighting department, and an official call for bids on the turbo-generator and accessory apparatus will be made in the near future. The steam plant, developing 25,000 kw., will supplement the hydro-electric developments at La Grande and on Lake Cushman owned and operated by Tacoma.

Extensions to the city of Seattle's light and power system to cost approximately $10,000,000, and authorization of the issuance of bonds in the same amount, are provided in a bill considered by the City Council and referred to committees. The undertakings outlined include the acquisition of a new steam generating plant, an addition to the Lake Union steam plant and purchase of property therefor, acquirement of substations and extensions thereto, and extensions of the distribution system within the city.

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U. S. Supreme Court to Hear Utility Versus City

IT WAS held by the United States Supreme Court on January 20 that a substantial federal question has been shown to exist in the case of the Yamhill Electric Company versus the City of McMinnville, Ore., and that the case can be properly taken up. The dispute arose over the action of the city of McMinnville in building a power plant and in sending the energy therefrom beyond the city boundaries into the territory served by the Yamhill Electric Company. In some instances, it is charged, the municipal plant has gone five miles beyond its corporate limits to serve private consumers with electricity for profit. The power company contends that the competition of the city is contrary to the Fourteenth Amendment. The Supreme Court of Oregon denied the plea of the Yamhill Electric Company. (ELECTRICAL WORLD, October 5, 1929, page 707.)

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Political Mills Grind Both South and North

SOME time this month the Texas Legislature, now in special session, will take up a bill creating a public utility commission whcih has been prepared by the City Attorneys' Association and approved by Governor Moody. This measure provides for a separate commission of three members appointed by the Governor. The body would not have the power to make rates, but would assemble precise data as to utility investments, capital investments and all the increments of utility operation. Should a public utility become dissatisfied with a city-made rate, it could appeal to the district court. The sustaining data for the city would be compiled and supplied by the state body. This is a radical departure from the legislation formerly proposed, which vested the commission with rate and regulation powers.

The committee on general laws of the Virginia Senate has reported favorably a bill for the establishment of a commission to protect Virginia's interests in the proposed Potomac River power development. An identical bill introduced in the House had already been reported out. The bills provide for a commission to enter into negotiations with the federal government and the

States of Maryland and West Virginia with respect to contemplated developments.

The Kentucky Senate has opened the way for hearings on the question whether Cumberland Falls shall become a power plant or a state park by adopting a resolution providing that any one interested in the project shall have a hearing. Both houses of the General Assembly have already adopted resolutions inviting T. Coleman du Pont to renew his offer to buy the falls site and adjoining acreage at a cost of around $200,000 and present it to the state.

Sheldon E. Wardwell, counsel for the Massachusetts Electric and Gas Association, has had introduced in the Legislature of that state a bill which provides that public utilities may appeal to the Department of Public Utilities for authority to establish high-power transmission lines in communities which deny permission. Opposition is based on the view that this would encroach on the rights of municipal light plants.

Under the provisions of a bill introduced in the New York State Senate the Public Service Commission law would be amended so as to provide that the commission shall not fix a value for rate-making purposes on so much of any company's property as was included in its latest annual report higher than the value placed thereon in such report. Some significance is attached to this bill, as Senator Hickey, by whom it has been introduced, is a member of the special legislative commission which has recently concluded hearings looking to the revision of the Public Service Commission law. The language of the bill suggests that it was introduced at the instance of the State Conference of Mayors, since its proposal resembles greatly their contention that there should be but one valuation allowed for rate-making and tax-making purposes.

Coming Meetings

Artistic Lighting Equipment Association—Washington, Feb. 9-15. C. L. Benjamin, 420 Lexington Ave., New York.

Empire State Gas and Electric Association — Commercial Section, Rochester, Feb. 13 and 14. C. H. B. Chapin, Grand Central Terminal, New York.

Northwest Electric Light and Power Association — Commercial Section, Spokane, Feb. 13-15; Accounting Section, Portland, March 17-18; Engineering Section, Aberdeen, Wash., probably week of March 23. B. Snow, 1206 Spalding Bldg., Portland, Ore.

North Central Division, N.E.L.A.—Engineering Section, Nicollet Hotel, Minneapolis, Feb. 24-25. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

Oklahoma Utilities Association — New Tulsa Hotel, Tulsa, March 11-13. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Illinois State Electrical Association—Hotel Abraham Lincoln, Springfield, March 19-20. George Schwaner, 205 Illinois Mine Workers' Building, Springfield.

Pacific Coast Electrical Association—Commercial Section, Fresno, Calif., March 20-21. G. T. Bigelow, Southern Sierras Power Co., Riverside, Calif.

Southeastern Division, N.E.L.A.—Bon Air-Vanderbilt Hotel, Augusta, Ga. April 15-17. C. M. Kilian, 207 Bona Allen Bldg., Atlanta, Ga.

Middle West Division, N.E.L.A.—Fort Des Moines Hotel, Des Moines, Iowa, April 23-25. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

National Electric Light Association—San Francisco, June 16-20. A. J. Marshall, 420 Lexington Avenue, New York.

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Topeka, St. Joseph and Long Island Lower Rates

POWER electric rates for Topeka, Kan., and its suburbs are contained in a new schedule filed by the Kansas Power & Light Company with the State Public Service Commission. Residence lighting schedules reduce the rate for the first step from 7 to 6½ cents per kilowatt-hour and from 5 to 4½ cents for the second step. New schedules for commercial lighting also show reduction. It is estimated that the reduction will mean a saving of approximately $75,000 per year.

A new schedule of electric rates, which, on the basis of last year's business, will save light and power customers of St. Joseph, Mo., $155,000, has just been put in effect by the St. Joseph Railway, Light, Heat & Power Company.

A reduction amounting to slightly more than 11 per cent begins on February 1 in the domestic rates of the Long Island Lighting Company and its subsidiary, the Queens Borough Gas & Electric Company according to a rate schedule just approved by the New York Public Service Commission.

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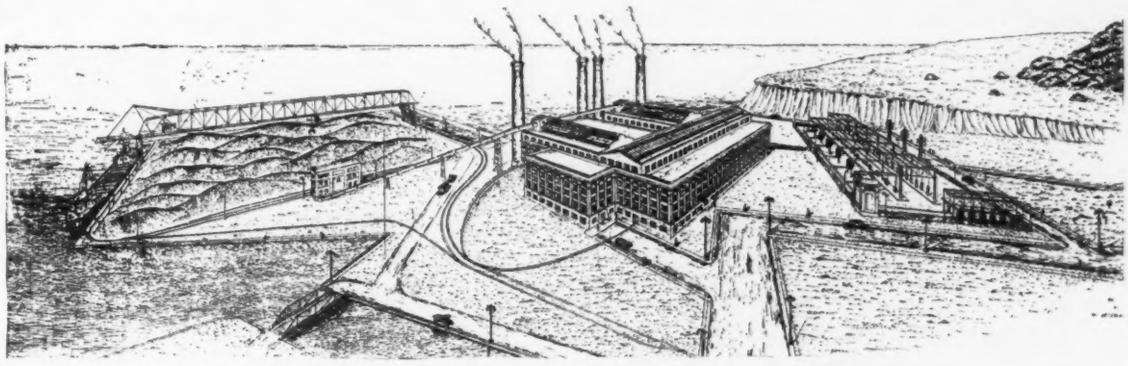
Seven Precincts of Eleven Vote Oklahoma Franchise

VICTORY was won in a franchise election in Ada, Okla., on January 21, when the citizens voted by a decisive majority to grant the Oklahoma Gas & Electric Company a renewal of its franchise. Out of eleven precincts all voted for the franchise but four, and these were lost by the narrow combined margin of 23 votes.

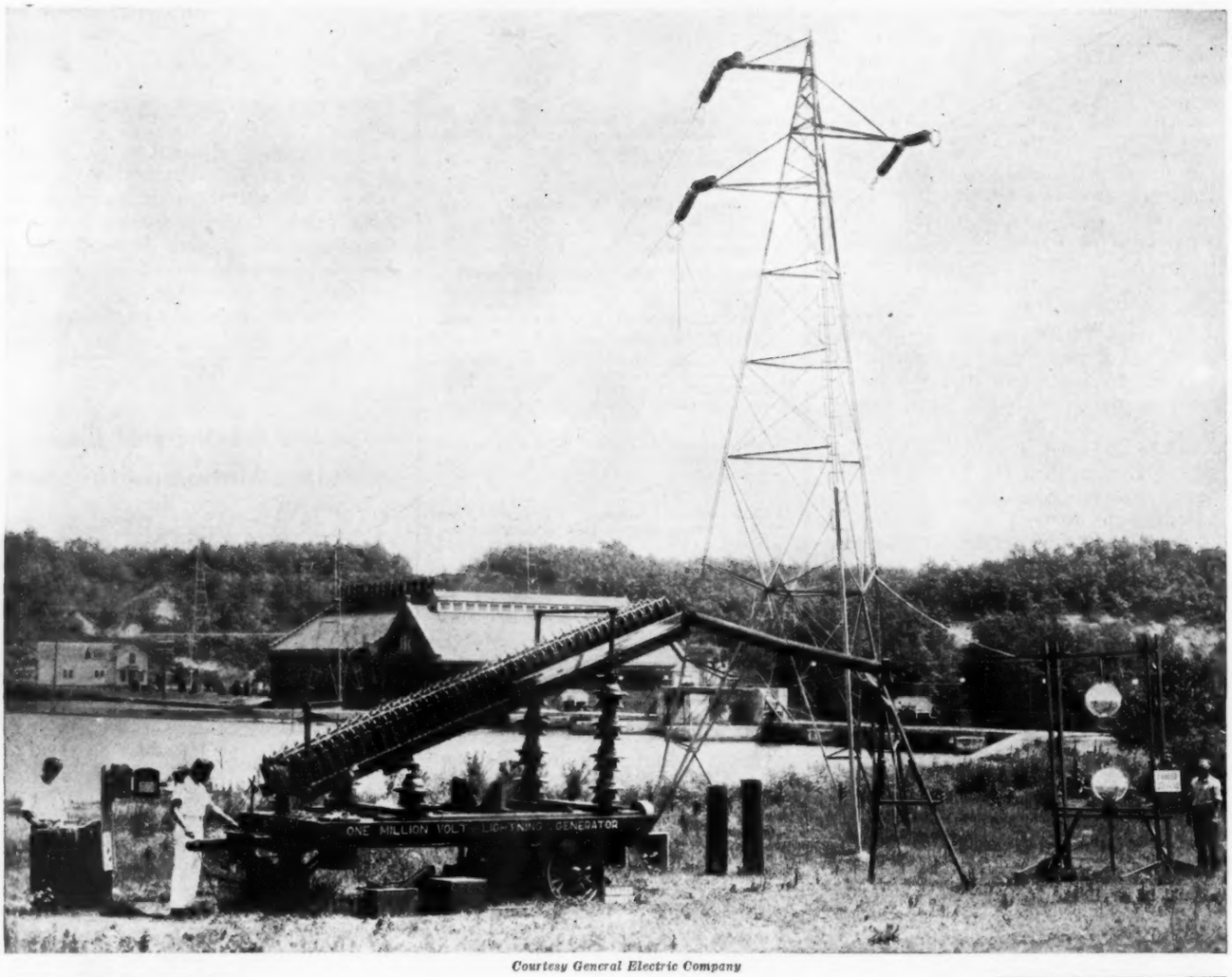
The Ada election was the result of the first electric franchise application filed by the Oklahoma Gas & Electric Company subsequent to the decision of the State Supreme Court declaring the revocable permit or indeterminate franchise act unconstitutional.



ANOTHER STEAM PLANT COMING ON LAKE MICHIGAN SHORE

An artist's drawing of the proposed Port Washington power plant of the Milwaukee Electric Railway & Light Company as it will look. Work is expected to start next spring. An initial capacity of 75,000 kw. is planned, at a cost of $8,000,000. Ultimately the plant will have a capacity of 300,000 kw. and will cost $25,000,000. The company has bought the Port Washington municipal plant for $180,000.

LIGHTNING WILL BE CONQUERED



Courtesy General Electric Company

ALTHOUGH yet untamed and yearly exacting heavy toll in faulty performance and interruptions to supply lines, the lightning demon, through continued laboratory tests and field research by the industry, becomes a less formidable foe. More test data on actual line surges, crests, wave fronts and attenuation following natural lightning are desperately needed. "Know your enemy" and the fight is all but won.

EDITORIALS

L.W.W. MORROW
Editor

Half Truths for Public Consumption

THE utilities have been heard. After eighteen months of investigation the Federal Trade Commission permitted their representatives to present evidence and give testimony regarding publicity activities. This was too late to prevent the spread over the nation of an impression that works injury to a great industry. It was too late to get newspaper publicity that would carry a competent interpretation of the facts in the record as contrasted with the mass of newspaper publicity and comment that flooded the country with half truths during the hearings.

It is only fair to remember that in this investigation the Federal Trade Commission is operating under a Senate resolution designed, if strictly followed, to bring out only an incomplete picture. Facts as to publicity and publicity operations are very well, but it would seem as if the commission could properly have permitted the utilities to show the necessity for the wide distribution of facts and the motives of those who originated the policy. This should have come first, for it was clearly needed in a complex industry in large measure dependent upon public favor for its continued ability to render service. Moreover, a complete survey of the entire situation would seem only fair in an investigation whose record may be the basis of legislation. A study of the record, however, leads to the conclusion that the investigation was one-sided, and the comments in cross-examination make it almost possible to predict the report that will be made to the Senate.

Some comment has been made to the effect that the representatives of the utilities have handled the publicity aspects of the investigation ineptly. It must not be overlooked that they worked under very difficult conditions. The Federal Trade Commission held strictly to narrow rulings when it could have exercised wider discretion in handling a situation so fraught with public and private interest.

There is one aspect of this matter that transcends the present investigation. For years the American public has been vaguely conscious of forces working to disrupt the whole structure of American industry. It is to be hoped that the data accumulated by the utilities and bearing on this larger movement will not be permitted to remain buried because of the veto of the Trade Commission. The American public is entitled to know how far the germ of unrest and discontent has inoculated the healthy body of American business.

Congress should insist that some impartial body make an appraisal of the propaganda that has been carried into our schools and colleges, our newspapers and our industries by the forces which openly assert that they are seeking "the gradual socialization of industry."

More Known About Lightning

FOR several years electrical engineers have been sniping at lightning, reconnoitering and waiting watchfully. The year 1929 witnessed allied forces, under the impulse of a common incentive, mustering the specialty troops and organizing a concerted offensive. The new weapons consisted of improved cathode-ray oscillographs, klydonographs and surge recorders, lightning-stroke recorders, field-intensity recorders, million-volt field guns and what not. Everything was concentrated on the objective. The morale was excellent, the shock troops so far forgetting the

instinctive human fear of lightning as to fear that there would be too little of it. The reports of the drive are now available, and it has been disclosed this week just what has been found out about the enemy's strength and method of attack. The Lichtenberg line has been broken.

There have been marked differences of opinion as to the magnitude, duration and wave form of the surges created by direct lightning strokes or propagated when bound charges were released by nearby flashes. On the subject of duration alone an extended revision of ideas is necessary because surges have been found to last twenty to seventy microseconds instead of enduring only five microseconds as several had previously contended. The predominance of positive surges signifies a preponderance of induced disturbances and indicates that the negative surges are more to be feared because they run to magnitudes twice as great as the positive. Data have been obtained likewise which confirm the hypotheses about the shielding efficacy of ground wires, but a closer analysis reverses the conceptions about the extent of their contribution to attenuation. The necessity for more careful establishment of uniformly low ground resistance is evident if the overhead ground conductors are to function unhampered.

The 1929 field studies, in short, represent the largest forward stride taken since the lightning problem emerged from the casual stage when voltages rose above mere distribution values. They have taken much of the mystery out of lightning and added it to the portfolio of nature's nonconstructive forces which we have in large part fathomed. Engineers are on the point of mastering it in so far as it has disrupted service on transmission systems. As in all similar situations, knowing the magnitude, the manner of action and the nature of the effects constitutes 90 per cent of the solution. The remainder of the co-ordinated attack will require a fuller appreciation of the fact that the route to better lightning protection on lines is by way of increasing lightning protection. More data are needed on the correct distribution of line arresters and on the most appropriate coordination of line and apparatus insulation.

Certainly, the mastery of lightning will approach the complete stage when more has been established as to the inherent nature of the lightning phenomenon and its quantitative manifestations independent of line-surge characteristics which flavor virtually all of the observations made to date. A more thorough knowledge will permit the envisioning of a lightning-proof line with every critically situated insulator functioning as a lightning arrester. This desired end can come within the realm of economic possibilities only as the line-type arrester attains the cost, life and performance status of today's reliable insulator.

State or Federal Courts?

UTILITIES believe in state regulation, yet frequently go into federal instead of state courts with rate cases. The latest instance has occurred in New York, where a United States court increased the Public Service Commission's valuation figures and allowed a 7 per cent instead of a 6 per cent return. This finding has stirred up Governor Roosevelt and others who contend that cases involving utility rates should be handled in state courts. The Legislature is attempting to get congressional action to force this procedure.

Fortunately, light and power companies have sufficient wisdom to keep out of courts with rate cases in most instances. This is the best policy. But in the event that it is necessary to protect constitutional rights resort must be had to courts. Whether state or federal courts are used depends upon analysis of conditions and costs and not upon such slogans as state rights or local regulation. It is to the advantage of customers and utility owners to arrive at a judicial decision quickly and in the most economical manner, and a multiplicity of courts and a mountain of legal fees inflict their economic penalties.

Rate cases involve constitutional clauses dealing with confiscation and property rights that have been applied most widely and uniformly by federal courts. These courts are skilled in these subjects, are quick in action and take a national point of view on a local situation. State courts are of many types, and litigation in them often involves a succession of decisions before the highest state court is reached. Each state differs from the others in its judicial framework and proced-

ure, so that a utility operating in several states encounters difficulty in meeting each state situation easily and with the least expense. State courts are prone to be local in their point of view in the application of national laws and in many instances are subject to great delays in reaching decisions.

Thus, without generalizing, it is well to consider all elements of the problem before stating that either state or federal courts should be used. The decision should be based on minimum total cost and minimum time to reach a decision that will be final. In most instances, at the present time, the federal court will reach a decision most rapidly and most economically.

Research Improves Circuit Breakers

RECENT scientific research into the switching field has at once brought new ideas and new life, new theoretical data and new and very promising types of circuit breakers.

The Deïon oilless breaker, which was presented to the electrical engineering profession at the winter convention of the American Institute of Electrical Engineers a year ago, was the result of clear and systematic scientific thought and was introduced simultaneously with a new theory of the electric arc. Now, at this year's winter convention, the further development, amplification and classification of the arc theory have been described, simultaneously with a presentation of further developments of the "Deïon" principle. The latter may not be so revolutionary as was the announcement of the oilless Deïon breaker, but nevertheless they promise to be of great importance, because the possibility of the application seems more immediate and more universal. This time it is not an oilless breaker, but rather the application of the results of the new study of the arc and the resulting Deïon principle to develop fully the oil circuit breaker.

Great improvements are claimed for oil breakers by the addition of Deïon chambers to the contacts. Numerous shop and field tests seem to indicate that oil breakers with Deïon contacts cause less disturbance on the system when clearing short circuits and less damage to the contacts. Further study and further testing may result in smaller tanks and less oil for the same rupturing capacity and even in a completely new design of breaker; but the reduction of system disturbances and the conservation of contacts are sufficient to mark this development as an important milestone.

Lax Engineering in Average Factory Wiring

WHY is motor switching and wiring in the average factory more complicated, less flexible and more expensive than in the average power house having comparable motor conditions? If anything, the problem is more difficult in the power house. And yet it would be difficult to find in a modern power house the awkward combinations of fitting upon fitting and box upon box, of a flexible conduit here and an open cable there, of a huge fuse box surrounded by an endless number of small boxes and cable splices without number, that are so common in the average factory.

Very few factories have any record of the conduit and cable system; the electrician is supposed to carry the information in his mind, but he generally cannot recall it when most needed. Cables are often too large and more often too small. There is no uniformity whatever in switching and starting equipment, the factory owner generally buying his motor and starter with the machine, so that in very many factories a regular museum results. This situation not only causes unnecessarily high first cost, because of the varieties that must be purchased, but also long interruptions when replacements must be made. Owing to the complexity of wiring and the absence of records, there are many complicated lawsuits as a result of fire, the electrical system often being blamed when some other cause is responsible.

The cause of all this trouble is that a competent electrical engineer is seldom called in to assist in the layout of the electric circuits and in specifying the type of motors and switching equipment to use in each case. These problems are generally left to the electrical contractors or to the shop electricians. Owners of factories will find it to their advantage to have the electrical system properly designed.

Each weight of axe has a definite heating cycle

Electric Heat SAVES $500 PER MONTH in Axe Factory

By WIRT S. SCOTT

Special Representative
Westinghouse Electric & Manufacturing Company

QUALITY production is so highly regarded by the Warren (Pa.) Axe & Tool Company that its officers would have been satisfied* with an increased operating cost after electric furnaces were installed provided uniform high-grade output was obtained. Instead of encountering higher costs since two electric furnaces were installed on February 1, 1929, costs have actually been cut over $500 per month as compared with the expense of operating five natural gas furnaces. Of far greater importance, electric heat treating has brought about the practical elimination of "rejects" in the field, enhancing the value of the product, saving labor and improving working conditions as well.

The Warren company manufactures the "Sager" brand of axes, hand forged from the highest quality of crucible steel. Other axes and logging tools are also produced by this house. Formerly heat treating was done in gas-fired furnaces, but despite the exercise of the greatest care, including the individual hardening and tempering of every axe by highly skilled operators, the desired uniformity of product could not be obtained. It was apparently impossible to secure the exact color tone indicating the correct tempering of the Sager brand without variation, and accordingly a decision was reached to adopt electric heat treating, without regard to its anticipated operating cost. A most welcome surprise in regard to these costs was in store for the company.

The entire method of heat treatment was virtually reversed by electricity. Batch type, semi-continuous opera-

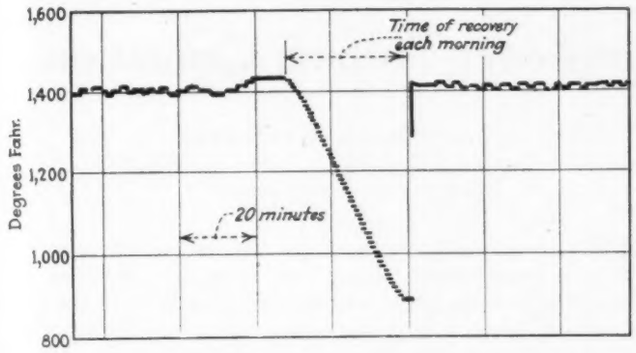
**From a recent paper before the A.S.M.E.*

What Furnace Operators Think About Electricity vs. Gas

With Gas Furnaces	With Electric Furnaces
Worked eight hours per day.	Work seven hours per day.
Hard work necessary every minute to get out production.	Plenty of time to do a good job, resting 1.5 to two minutes out of every eight.
Had to be on job practically every second or some overheated axes would result.	Are making as much money in seven hours as formerly made in eight.
Intense heat given off by furnaces made working conditions almost unbearable, especially in summer.	No discomfort at all from heat. Scarcely realize that baths are hot.
	Instead of having the hardest and most uncomfortable job in the plant, the operators now have the easiest job.

Electric furnaces have so improved the working conditions that it would be worth accepting less money rather than to return to the old method.

tion was adopted; bath type furnaces replaced the hearth type, and one hardening furnace and one tempering furnace superseded five gas-fired combination hardening and tempering units. Hardening is done at 1,405 deg. F. and tempering at 580 deg. Only the blades are heat-treated; hence it is unnecessary to heat the entire axe except for obtaining the blue finish on the "Sager" brand, which is done in the tempering bath. In the hardening bath 23 axes are suspended at a time. A blanket of granular carbon is placed on top of the molten lead, reducing radiation losses from the surface. The time and temperature requirements in both processes must be definitely controlled in order to obtain the desired metallurgical results. Various experiments with thermostatic control methods led to a control of the hardening temperature within 15 deg., which was a tremendous improvement over any results anticipated by the Warren company, and the elimination of 80 per cent of the field rejects was brought within reach. By the use of two control instruments, two separate contactor switches and two circuits in each furnace the temperature fluctuation from normal has been brought down to 7.5 deg. and rejects from heat treatment virtually eliminated.



Temperature fluctuations are sharply restricted in the electric hardening furnace

The furnaces are never permitted to cool off enough to cause the bath liquid to solidify except at week-ends. At the end of each day's run insulated covers are lowered over the entire furnace top. The following data show the excellent heat storage obtained:

Characteristic Operations

	Hardening	Tempering
Inside dimensions (inches)	22 x 60 x 14	12 x 46 x 12
Operating temperature of bath, (deg. F.)	1405	580
Hours operated per day	7	7
Operating hours	7 a.m.–12 noon 12:30 p.m.–2:30 p.m.	7 a.m.–12 noon 12:30 p.m.–2:30 p.m.
Number of hours each day furnace is shut down before energy is again applied	15.5	15.75
Temperature of bath when energy is applied (deg. F.)	840–900	450–480
Time required to reach operating temperature (minutes)	30–35	[illegible]
Time held at operating temperature to secure heat saturation (minutes)	30	20

In hardening, five minutes is allowed for the complete cycle with 4-lb., single-bit axes, eight minutes being allowed with 6.5-lb. axes. When tempering 4.5-lb.

Electric Heat Benefits Offset a $9,038 Investment in Eighteen Months

Monthly production basis, 8,320 double-bit and 25,350 single-bit axes

	Estimated Comparative Monthly Cost Two Electric Furnaces	Five Gas Furnaces
Electric or fuel bill	$276.00	$150.00
Labor for heat treatment	318.00	726.00
Testing, inspecting, field rejects, etc.	167.00	667.00
Maintenance	159.80	14.90
Investment charge at 15 per cent	133.00	.....
Total	**$1,053.80**	**$1,557.90**

Net actual book profit per month with electric heat	**$504.10**
Estimated added sales value of product per month	350.00
Cost of electric furnaces and control	9,038.85
Price of natural gas per 1,000 ft., cents	.43
Cost of electric power per kilowatt-hour, cents	2

Direct Labor Cost per 100 Axes Hardened and Tempered

	Gas Furnaces	Electric Furnaces
Single bit	$1.73	$0.85
Double bit	3.46	1.24

Monthly labor cost. 8,320 double-bit and 25,350 single-bit axes, gas furnaces, $726; electric, $318.

Maintenance Costs of Electric Hardening and Tempering Furnaces

(Estimated)

Vessel cost, $800 (nickel chromium)		
Use per month, 200 hours		
Depreciation, $23.20		$23.20
Lead consumption per month		
280 lb. lead	$24.50	
28 lb. tin	6.50	
Total	$31.00	31.00
Granular carbon per month		
One ton lasts nine months, cost	$50.00	
Cost per month	5.60	5.60
Salt consumption per month for tempering		
1 bbl. costs $75 (Warren specifications) and lasts three weeks.		
Cost per month	$100.00	100.00
Total		**$159.80**

double-bit axes, both points at once, the immersion time was eight minutes. The tempering bath holds 26 double-bit axes or 29 "single bladers."

The two furnace operators are on piece work, each turning out from 1,400 to 1,500 axes per day with a four-months' average of 1,435 each. These two men produce more work than five heat treaters did under gas operation, are not rushed as they were in the past to average a certain daily wage, and have immeasurably better working conditions.

Improved quality of product

With gas heat an attempt was made to hold the hardness between 53 and 57 Rockwell, "C" scale (518 to 568 Brinell). With electric heat the results are coming uniformly between 54 and 56 Rockwell (530-555 Brinell). The difference in the hardness of the inside and outside corners of the same axe bit with gas heat frequently amounted to the high and low limits set, whereas with electric heat the difference is never more than 1:5 points Rockwell test. From the performance to date of the electric furnaces it appears certain that the field rejects due to heat treatment will be entirely eliminated. To insure a high-grade uniform quality product when using fuel furnaces a considerable amount of added expense was necessary, which has been eliminated in some cases and materially reduced in others. The yearly value of this item in the reduction of testing, inspection, reduction of field replacements, etc., will amount to $8,000 a year.

The electric furnace has brought about reduction in labor cost as well as a higher quality of product, enhancing the trade distinction of the commodity. This added sales advantage is estimated at $350.

Wide margin in favor of electricity

The estimated over-all cost of heat treating axes in this plant by the two electric furnaces is $1,053.80, compared with $1,557.90 for the gas furnaces, and if the added sales value of the improved product is included, the total savings per month figure $854.10. Based on the actual book profit shown for electric heat of $504 per month, the equipment, completely installed at a cost of $9,038.85, will pay for itself in eighteen months.

AN ELECTRIC LIGHT AND POWER COMPANY by itself can make no enemies, can gain no friends, can do no wrong. Such friends as it has, those engaged in the industry must gain for it. Such enemies as it gets, those in the industry make for it. It has only such character as the men and women who are operating and managing these companies give to it.

P. S. ARKWRIGHT,
President Georgia Power Company

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Washed Oil Improves Turbine Operation

By JOHN A. BARNARD
Superintendent Delaware Generating Station, Philadelphia Electric Company

THE continuous operation of large steam turbines is to a great degree dependent upon the condition of the oil that is used for lubrication. As is well known, oil which contains acid materials and sludge in solution will deposit sludge if this oil is agitated with water. The oil reservoir of a steam turbine is almost an ideal sludging tank, since unexpected steam leaks supply water and agitation is produced by the oil pump which forces oil through the bearings. Sludge emulsion clogs the oil lines, reduces oil cooler efficiency, increases bearing temperatures, eventually requiring that unit be taken out of service for cleaning.

In the evolution of conditioning oil, the continuous water washing (DeLaval-Funk) process has been developed and is now in operation on fourteen turbines (30,000 to 60,000 kw.) of the Philadelphia Electric System. It employs the principle of removing, outside the turbine, the products of oxidation of the oil as formed. The first result of the oxidation of turbine oil during service is the formation of certain organic acids.

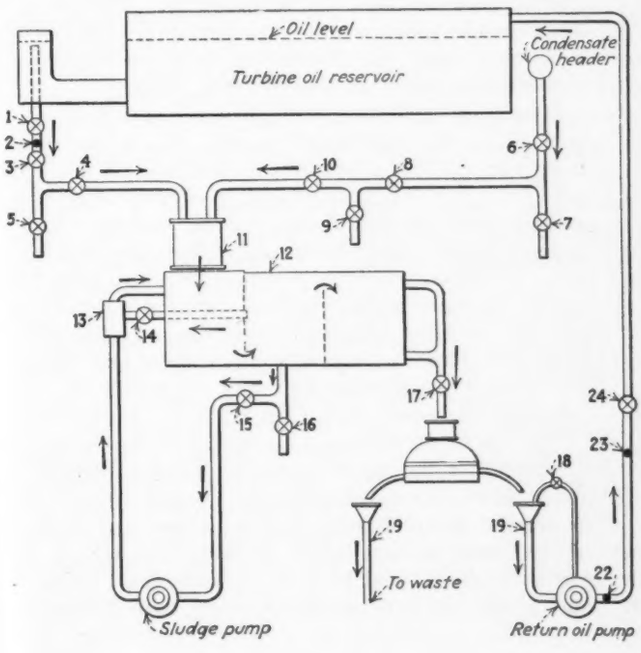
In the DeLaval-Funk system a small quantity of oil is constantly drawn from the turbine reservoir and enters the sludge tank together with 20 per cent of condensate through the sight mixing glass. By means of a small gear pump and a suction tee an emulsion is produced in

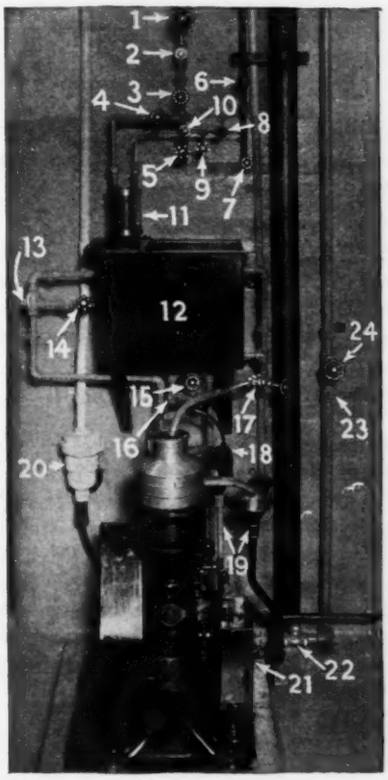
the first and second sections of the sludge tank. The emulsion then passes over the second baffle into the third section of the sludge tank and from there to the oil purifier. The acid, which is soluble in water, is removed and discharged to waste. The soluble sludge which has formed the emulsion with water is deposited in the bowl of the oil purifier and the clean oil is returned to the turbine reservoir. It has been found that it is necessary to clean the bowl of the oil purifier about twice per week. The operation is continuous whether the turbine unit is in or out of service.

In 1925 one 30,000-kw. unit at the Delaware station of the Philadelphia Electric Company was equipped with sludging apparatus and a DeLaval oil purifier. Careful record was kept in comparison with other means of conditioning the oil then in use at the same station. It is interesting to note the acidity increase of the oil of two units, No. 1 and No. 2, 30,000-kw. General Electric Company turbines, each charged with the same kind of new turbine oil (850 gal.). No. 1 turbine was operated with a DeLaval-Funk continuous water washing equipment, while No. 2 used the intermittent cleaning process. After 4,600 running hours records were discontinued on No. 2. During the 4,600 hours' run on No. 2 about 425 lb. of sludge was removed from the oil cooler, reserves and oil lines, while from the bowl of centrifuge No. 1 16.6 lb. of sludge was collected (and no deposit of consequence could be found in the oil system of unit during the first 5,000 hours). With 10,200 running hours on No. 1, 34 lb. of sediment was removed from the turbine reservoir and the accumulative deposit taken from the separator bowl brought the total to 108 lb. At 13,000 running hours the total sludge removed was 141 lb. At this time the weight record was discontinued.

The rapid rise of the neutralization number of No. 2 compared to No. 1, and the removal of soluble sludge outside of the turbine reservoir, which reduces the formation of sludge in the system reflects favorably toward No. 1 from an operating viewpoint.

The acidity records obtained for No. 1 cover an elapsed time of a little over four years without cleaning the oil cooler tube bundle on this unit. The oil required for make-up has also been materially reduced since the losses due to frequent cleaning do not occur.





Continuous water-washed purification for turbine oil

1. Main oil shut-off valve in oil supply line. 2. Emergency connection plug in oil supply line used in connection with plug No. 23, so that pipe connections may be made to by-pass the sludge tank and install a larger portable oil purifier temporarily, in case of excessive water leakage into turbine oil reservoir. 3. Oil regulating needle valve used to regulate the quantity of oil required to form the emulsion in the sludge tank. 4. Shut-off valve for oil regulation. This valve may be closed and the quantity of oil flowing may be measured from test valve (No. 5).

5. Oil test valve for checking quantity of oil flowing. 6. Main water shut-off valve in condensate supply line. 7. The water blow-down valve gives free blow of condensate supply line and thus removes at intervals any deposit in this line which might clog the ¼ in. needle valve. 8. Regulating needle valve used to control the small quantity of water required to form the emulsion in the sludge tank. 9. Water test valve for checking quantity of water flowing.

10. Water shut-off valve, used to shut off the water going to the sludge tank so that the quantity may be measured from test valve (9). 11. Sight-feed glass where oil and water may be seen flowing to sludge tank. 12. Sludge tank. 13. Suction tee operated by the discharge mixture of oil and water from the sludge pump. Sufficient velocity is obtained through the orifice in the tee to draw emulsion from the middle section of the sludging tank and discharge the mixture to the tank directly in the path of the incoming oil and water. 14. Regulating valve to suction tee.

15. Sludge pump suction valve obviates the necessity of drawing the sludge tank while repairs are being made on the sludge pump. 16. Sludge tank drain valve used to drain the tank for periodic cleaning. 17. Valve from sludge tank to oil purifier used to shut off the emulsion flowing to the purifier when the bowl is being cleaned. 18. Return oil pump air vent. 19. Clean oil and waste water funnels.

20. Power supply. Plug may be removed and large portable separator plugged in without delay. 21. Starting switch. The motor drives the oil purifier as well as the sludge pump and the return oil pump. 22. Check valve. Clean oil return. 23. Emergency connection plug in oil return line used in conjunction with plug (No. 2). 24. Main oil shut-off valve in oil return line.

Regular Breaker Inspection Insures Better Service

By H. T. SUTCLIFFE
Assistant Engineer, Pacific Gas & Electric Company

ALTHOUGH considerable effort has been expended during the past few years in improving the electrical characteristics of the circuit breaker, mechanical features of the device and its operating mechanism still leave much to be desired. As a consequence of these inherent characteristics the operator must exercise the greatest vigilance in keeping the breaker and its associated mech-

PACIFIC GAS AND ELECTRIC CO.
RECORD OF OIL CIRCUIT BREAKER MAINTENANCE
(Instructions on Reverse Side)
Station "X" Month Oct. 1929

BREAKER NO.	TYPE	LINE VOLTS	DATE LAST OIL TESTED	OPERATIONS DURING MONTH	TOTAL NUMBER OF UNIT OPERATIONS AS OF DATES BELOW 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	DATE OVERHAULED THIS YEAR	DATE OVERHAULED LAST YEAR
1	60	6/29	50		106 105		7/17
6	60	5/17	110		118 115		7/17
300	11	8/5	35		34 37 112		6/17
400	11	9/26	15		14		6/17
600	11	9/10	75		76 79 80 182	10/29	10/28
600	11	1/31	60		61 68		6/17
—							
600	11	10/9	—		1 3 4 5	10/29	

Maintenance record shows "unit" operations and dates overhauled

anism in the highest possible state of preparedness for duty. Some logical plan for accomplishing this with a minimum of inspection and overhaul and consequent cost becomes essential whether a power company, large industrial plant or other user be involved.

The accompanying form was developed by the Pacific Gas & Electric Company in an effort to determine, by recording the performance of the various oil circuit breakers on its system, the time when inspection or overhaul was required. The idea suggesting this plan was not original, it being borrowed from one of the other Pacific Coast utilities and elaborated upon and adapted to fit the needs of the Pacific Gas & Electric System. This form is filled out and kept on file in each station and covers all oil circuit breakers in that station which operate at 6,600 volts or over, excepting breakers on motor-generators which are not operated when the machines are in parallel or under load, such breakers being overhauled every six months.

When a circuit breaker trips under actual service conditions the foreman or operator values such duty in terms of "unit operations." A unit operation is defined, for the purpose of this plan, as the duty imposed by the opening of the circuit breaker under normal load with no trouble on the circuit. The number of unit operations thus assigned is determined by the foreman or operator in accordance with his judgment of the duty imposed upon the breaker in opening the circuit, based upon observation of its performance and past experience with the particular type of breaker involved.

Circuit breakers are inspected and overhauled after 125 unit operations. The date of overhauling is entered in the log and a series of data started for any subsequent operations in that month. If immediate overhauling is not possible after 125 unit operations, the record of operations is continued to show the total number of unit operations prior to overhauling. Overhauling implies thoroughly inspecting the breaker, including the control mechanism, dressing or renewing contacts, reconditioning oil and making such other repairs, replacements and adjustments as may be found necessary to replace the circuit breaker in first-class operating condition. This work is carried out, excepting in a few of the larger stations, by traveling maintenance crews.

It will be seen that the decision to inspect or overhaul is, in the last analysis, still dependent upon the judgment of the operator or observer of the switch's performance. That judgment, however, is guided and made a basis of cumulative record, and the element of memory is eliminated, resulting in increased efficiency.

In all cases where a breaker has not been tripped either manually or automatically during a period of six months (or less when local conditions require), it is inspected as thoroughly as possible from the outside and the control mechanism is tested to insure its opening automatically when called upon.

The oil in all breakers operating on voltages from 6 kv. to 30 kv. inclusive is tested every six months, and above 30 kv. every three months, irrespective of whether or not the circuit breaker has been operated. When the oil is found to test below 17,000 volts with a 0.1 in. gap it is filtered and brought up to at least 22,500 volts, and usually to around 30,000 volts with the same gap.

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Grounds for Federal Regulation Extremely Limited

OTHE 1928 consumption of electrical energy 89.3 per cent was consumed within the state where it was generated and 10.7 per cent crossed state lines. The portion generated in one state and sold to another company for distribution to consumers in another state amounted to 4.1 per cent. The portion generated in one state and distributed directly to consumers in another, with no independent agency intervening amounted to 6.6 per cent.

"Except for the supervision, if desirable, of wholesale interstate transactions, which comprehend only 4.11 per cent of the electrical energy generated and sold in the United States, there is no field for federal regulation of charges for electrical service unless it is deemed desirable to deprive the state authorities of part of the regulatory powers they now possess."

JOSIAH T. NEWCOMB,
Joint Committee of National Utility Associations.

PROPAGANDA OR PUBLICITY?

THE TAKING OF EVIDENCE concerning the publicity activities of utilities has been practically completed by the Federal Trade Commission. At the final hearings Bernard F. Weadock, counsel for the utility associations, presented the utility evidence and exhibits and P. S. Arkwright testified in regard to the basic industry developments and the National Electric Light Association policies and activities. In a sense, these presentations covered the utility side of the case, and the voluminous report developed in the hearings from January 8 to 18, 1930, has been abstracted by the ELECTRICAL WORLD for the benefit of the readers. The entire report is interesting and informative and well worth while to students of the industry.

IF YOU understand the utility business and the policy of its leaders there is reason for its publicity activities. This is the major thought developed by the testimony of Messrs. Weadock and Arkwright before the Federal Trade Commission. But these gentlemen had difficulty in getting this point of view into the record, for the commission has ruled consistently that its business is to follow the Congressional mandate to find out exactly what the public utility publicity activities are from the people who conduct them. It is not the business of the commission to deal with intents or policies. This ruling has made it difficult for the public or the industry to get a clear understanding of the publicity activities.

In the presentation of his testimony Mr. Weadock first outlined briefly the growth of the industry and the elements introduced by changing conditions. He pointed out that the era of the local plant changed to one of consolidation under war stimulus and economic pressure. He pointed out the financial difficulty encountered during the war period and showed letters from Woodrow Wilson and Secretary McAdoo supporting the contention that utilities were necessary assets in waging war and should be kept in financial health.

The economic pressure to consolidate local companies and to secure financial aid caused the development of the modern holding company and put the light and power industry into the class of "Big Business." With "Big Business" and the public service aspects of the industry so dominating, it was natural to develop ways and means of telling the public about the industry. This principle applies to all modern business and is supported by national leaders. Judge Weadock then stated that he "proposed to show that the activities of the utilities were inaugurated with the idea that all of the publicity or information that was in the possession of the industry groups should be sent to whoever might read it with the idea that there had been, on the whole, no effort at secrecy, no undercover methods, but, quite the contrary, that it was the obligation of these utilities freely, widely and openly to tell their story."

He went on to point out that the plan was freely carried out except for the zeal and enthusiasm of a few, but that, considering the number engaged in the work, the mistakes had been few.

Under the subjects of schools, colleges, newspapers, advertising, public relations, church lectures, Boy Scouts, text books, public ownership, legislative matters, Muscle Shoals and a campaign on the part of individuals and organizations opposed to private development by private companies Mr. Weadock introduced exhibits and facts to support his contentions.

He pointed out that there were 28 information bureaus instituted, covering 39 states, and that these agencies were to carry information fully and completely to the public. State by state, Mr. Weadock took up the publicity activities of these bureaus and stated the number of requests for material from schools and the degree to which state or local school authorities had authorized the distribution of this factual material. In attempts to

show comments of educators as to the material or its value, Commissioner McCulloch ruled that this was beside the point. He said: "I think it is all right to show that the school people solicited these contributions to their literature propaganda, or whatever you call it, but I do not see the pertinency of anything the school interests did after the propaganda went into the schools. It is a mere expression of opinion of the school people." In another instance Commissioner McCulloch said: "It is not important what they thought about it. The fact that is important is that they asked for them. You are defending the acts of the utility companies now, and are not testing the views of other people, and in order to determine the public being back of the utility association you show that you did not send them out voluntarily, but sent them out on request. That is all right."

The Commissioner held quite strictly to the general principle that the commission wanted only the facts about the publicity acts. Each pamphlet was the evidence as it was printed and not subject to explanations or comment as to its value in the minds of educators.

A Matter of Intent

"As I view it, all of our public relations work is being conducted, in your opinion, to offset government ownership, whereas I take the position that a great deal of it has no such *intention*, but all of it has that effect."—*Mr. Arkwright to Judge Healy.*

Perhaps the most significant interchange is the following: Commissioner McCulloch—"I said a while ago it is competent to show what your purpose it. That is probably straining the language a little. It is only fair to show what your motives were, but I can't see that any expression from any group of people now would have any bearing on your motive. It would be delegating to this group of people the authority to interpret this so-called propaganda, and it is the duty of the commission here, or the Senate, which deals with our report, to pass judgment upon that propaganda.

Mr. Weadock: "Precisely, and when your Honor comes to forming that judgment, one of the elements I assume that you will take into consideration in a determination of the merits or lack of merits of these particular things is, are they useful? Are they of value for educational purposes in the opinion of educators? Do they constitute propaganda or are they factual?"

Commissioner McCulloch: "If I were going to act in a legislative capacity to determine legislation on that subject, I would like to know what the school men thought about it, but in determining the question as to whether this has any tendency to influence puplic opinion on the question of public ownership, I do not know that I feel like delegating that connection to anybody where it rested on me to reach the interpretation myself. We do not know about these people. Some of their opinions are worth something and some of them are not. If we wanted to ask for opinions we would get the opinions of all of them."

In concluding his presentation Mr. Weadock said the school pamphlets have the approval of the state educational officials of Kansas, Louisiana, Mississippi, Michigan, Missouri, Ohio, Oregon, West Virginia, New Jersey, Tennessee and Washington. No pamphlets were issued to schools in Arkansas, Florida, Georgia, Kentucky, North Carolina, South Carolina, Minnesota or Virginia, and in California 1,500 were submitted to teachers to show that there was no propaganda in them. The evidence showed that requests had been received from 7,937 teachers in different sections of the country, including 1,589 superintendents, state, city and district; 2,302 principals and 2,864 schools. His concluding statement was as follows: "I would like to call the commission's attention to the fact that there never has been, according to this evidence, any effort at secrecy, nor to hide the source from which the information came; that there has been no direct association with pupils of any school; nor that there is any direct reference to government ownership or municipal ownership except in the pamphlet of one state."

As a next step Mr. Weadock submitted a brief covering advertising expenditures by utilities and a legislative

Rules of the Business Game—Woodrow Wilson, 1915

First of all is the rule of publicity—not doing anything under cover—let the public know what you are doing and judge of it according as it is. If a business is being honestly done and successfully done, you ought to be pleased to turn it inside out, and let the people whom you are inviting to invest in it see exactly how it is done, and with what results. Publicity which is required in sport is required in business. Let us see how you are running the game.

Purpose of the Joint Committee—George B. Cortelyou, 1927

There is neither mystery nor hidden purpose in the program of the joint committee. Its work will be carried on openly and frankly. It seeks no favors. It asks only that its presentation of the utility situation be considered and dealt with on its merits. But that such presentation may be so dealt with, it exercises the common right of all American citizens or organizations to be heard on all matters in which they are interested that become subjects of public debate or decision, and having presented its case it will, with confidence, abide by the informed judgment of the people.

A Bit of Significant Argument

JUDGE R. E. HEALY, chief counsel for the Federal Trade Commission:

"Suppose that you, who own the corporation, want to organize a new corporation to own it. You do not have any trouble about persuading the new corporation to take your property at an increased price and issue stock in return for it?

PRESTON S. ARKWRIGHT, President Georgia Power Company:

"Certainly not."

JUDGE HEALY: "Under present-day valuation?"

MR. ARKWRIGHT: "Certainly not."

JUDGE HEALY: "And when that device is resorted to, the difficulty that we are just talking about is avoided, isn't it?"

MR. ARKWRIGHT: "Yes, but what harm is done?"

JUDGE HEALY: "What harm is done? The harm that is done is this. In rate cases the valuation, of course, at which that property is sold, whether it is the reproduction value or not, has its influence on the making of rates. It has this further difficulty, that the stock that is issued in payment for the property is sold to the public, and then at the same time your people put into pamphlets that go into schools and public libraries and other places that this business is not conducted for a profit as other businesses are, whereas you make a profit in that change and in that increase in value, which gets capitalized now and again by some such means as I have pointed out."

MR. ARKWRIGHT: "It is open to argument, Judge Healy, as to whether it is a profit at all or not. The rise in value of property, if you choose to put it that way, merely represents in this day and time the shrinkage in the value of the dollar.

COMMISSIONER MCCULLOCH: That is like saying there is no such thing as darkness. It is only the absence of light."

MR. ARKWRIGHT: "No, I do not think so, your Honor. It is a gradual increase in the usefulness of property, the productiveness of property, which ordinarily increases the value. The increase in this instance is brought about by economic changes, brought about as the result of the war, which made the prices of everything very much higher, which reduced the exchange value of the denomination you have given to your currency, and that is all there is to it."

summary of Muscle Shoals. He dealt with the examination of text books and showed this practice was not confined to the utility industry. The National Retail Hardware Association, for instance, examined 110 arithmetics and found that 90 of them contained inaccurate statements. He dealt with the hiring of college professors, buying of newspapers and other matters quite fully dealt with in previous hearings.

The commission excluded from the record evidence of inquiries by a legislature and a university of the work of certain professors named in the earlier testimony, which documents indicated that a thorough examination was had and that the professors were retained by the university, one at an increased salary.

In his testimony Preston S. Arkwright outlined to the commission the scope and work of the National Electric Light Association. He traced its history as an organization that had developed to supply an agency for clearing information and practices that meant better service and cheaper service. He traced the development of the industry and the corresponding changes in the work of N.E.L.A. He made it clear that it is a voluntary association with no control of operations or management of any utility, and with no power over the acts or expressions of any member of the association, and was not a price-fixing association. It is a service organization to stimulate, assist, improve and co-ordinate the activities of the utilities. He developed the policy of the utility on service, rates, finance and management and showed the interrelationship of utility departments and of association committees. He told of the dues, expenditures and details of activities of the association. In the public policy and publicity aspects of the business Mr. Arkwright gave a very able presentation of the motives of utility leaders in the work and outlined the reasons for direct action. He discussed service, monopoly privileges, public contacts, political relations and utility regulation. His complete statement gives the philosophy of the modern utility executive and outlines utility practices and activities.

In the cross-examination of Mr. Arkwright the consolidation of utility properties was accented and the relation of this consolidation to finance, management and the growth of holding companies. A significant interchange is as follows:

Judge Healy: "The state commissions, I think you will agree, cannot regulate the interstate transmission of electric power."

Mr. Arkwright: "I do not know whether they can or not. Perhaps they can, as far as any effect is concerned if the federal government does not itself enter the field of regulation, although the federal government may have the power."

Mr. Arkwright developed the thought that the public was protected, since each state commission controlled rates charged consumers despite any interstate power contracts.

Stock ownership without voting power by customer owners was the subject of discussion. Also the sale of voting stock to a security holding company was treated, including the financial relations of the Georgia Power Company with the Southeastern Power Company and the Commonwealth

Modern Business—
Woodrow Wilson, 1915

The era of private business in the sense of business conducted with the money of the partners, I mean the managing partners, is practically passed, not only in this country but almost everywhere. Therefore almost all business has a direct responsibility to the public in general. We owe a constant report to the public whose money we are constantly asking for, in order to conduct the business itself. Therefore, we have got to trade not only on our efficiency, not only on the service that we render, but on the confidence that we cultivate.

& Southern Corporation. The examination at times became argumentative, but Mr. Arkwright gave opinions as opinions and stated only the facts that he knew.

As a final aspect of the hearings Mr. Weadock brought up the fact that utility publicity activities were in a measure defensive against individuals and organizations advocating public ownership. The commission held that this statement should be permitted in the record and that a list of these organizations be entered, but it would not permit Mr. Weadock to include the material that showed the activities of this group. Commissioner McCulloch ruled that the commission was investigating the acts of the utilities only and that the hearings could not be opened to permit other organizations or individuals to be brought into the picture unless these organizations had the right of testimony. This was held to be unnecessary and beyond the scope of the investigation.

Salient conclusions from the hearings

Under the subject of schools, it was shown that pamphlets were distributed to teachers only and no direct contact was had with the pupils; in regard to colleges it was shown that the vast majority of the work done by college professors was of a technical nature and that Mr. Weadock stated that the industry would abide by any code of ethics that the committee appointed by college professors would name; in regard to newspapers, he stated that there was no ownership of newspapers shown by utilities except one company, and that that company had advised the commission it had sold its interests; in regard to advertising, it was clearly shown that the sum of $28,000,000 to $30,000,000 said to have been expended was grossly exaggerated and a brief on advertising, giving the classification of expenditures, was introduced showing that not to exceed $8,000,000 was spent, which is a relatively small amount compared to one of the leading individual companies in the United States.

Letters from the clergy were introduced showing that the lectures delivered in churches were upon the subject of the Holy Land and no reference was made in any of them to the question of government ownership; a letter from a boy scout master showed that the scout master requested the privilege of distributing literature in order to obtain funds for the boys and that the money paid was the equivalent of what the postage would have been; in regard to textbooks, it was shown that they were examined for the purpose of ascertaining what was in them and that fraud, corruption and bribery of public officials appeared in many, and that in only a few instances was anything done to correct the erroneous statements contained in the books, and this was done through the publishers or authors; in regard to public ownership, it was stated that the companies, as such, are not interested in public ownership, but that whatever they did in regard to public ownership was in defense of their properties against the attacks of an alliance of several organizations which have for ten years or more made a concerted attack upon the electrical industry in order to further their program of government ownership of private industry and the abolishment of private business for gain, and showed by exhibits which were excluded that their plan contemplated government ownership of banks, ships, insurance, mines, coal and other basic industries; in regard to legislative matters it was contended that the right of petition was still operative and that the companies had a right to present to legislative bodies their side of questions to the same extent that any American citizen had.

A most interesting document on Muscle Shoals was presented showing the legislative history from the year 1824 to date, in which it was shown that money was first appropriated for the making of a canal at Muscle Shoals and that the State of Alabama had received 400,000 acres of land for this purpose and after many years the canal was built, but was not usable because it was not deep enough. It was also shown in the same exhibit that a power company had spent approximately $500,000 in acquiring land, making tests and obtaining plans for the construction of a power plant at that point, all of which land, plans, etc., were turned over to the government at the time of the war for the sum of $1, and that subsequently the same company was fined $500 for printing a copy of the check which the government had given it. The exhibit also showed that government ownership and operation as such were not involved in the Muscle Shoals question until within two years ago; that in regard to government ownership the record now shows that the League for Industrial Democracy, the National Popular Government League, the Public Ownership League of America and the People's Legislative Service are the instrumentalities urging government ownership. Mr. Weadock proposed to introduce approximately 100 pamphlets issued by the last-named organizations to show an alliance between them for the purpose of taking over private industry.

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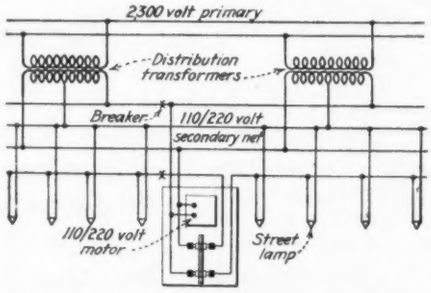
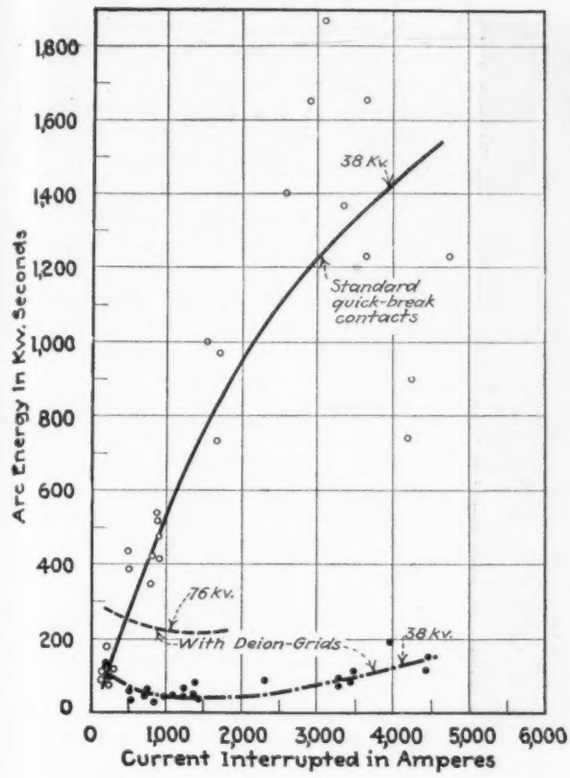
Multiple Lighting Balanced on Distribution Transformers

A METHOD of loading both halves of three-wire secondary circuits and the transformer feeding them has been developed by the Syracuse Lighting Company in connection with multiple street lighting. A two-pole time switch is used as shown in the sketch. It will be seen that placing it in the middle of the run of multiple lights permits balancing the load. The motor is connected to the 220-volt potential.



Multiple lighting load balanced on secondary

The Sauter time switch motor and contacts have been adapted for 220-volt operation. The street lamp circuit is split and one-half put on each side of the secondary.



Arc energy in new circuit breaker is low

Deion Grids for Oil Breakers

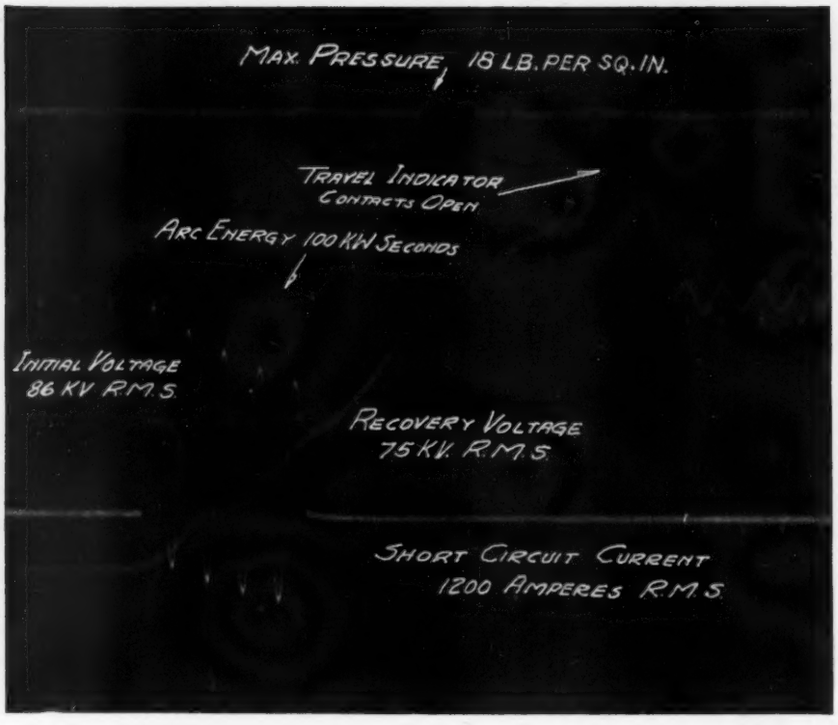
LAST YEAR at the A.I.E.E. winter convention the revolutionary Deïon principle was made public and test and experience data reported upon. This year the extension of a variation of this principle to the conventional type of oil circuit breaker by relatively slight changes indicates a vast field for the attainment of improved breaker operation.

THEORETICAL CONSIDERATIONS were covered by J. Slepian and test results reported upon by B. P. Baker and H. M. Wilcox, all of the Westinghouse Electric & Manufacturing Company, at the A.I.E.E. convention in New York during the past week.

TO BE most effective in alternating-current arc extinction an oil circuit breaker must be capable of drawing and maintaining the arc continually in contact with fresh oil. This contact between arc and oil must be sufficient to produce a high rate of decomposition of the oil and the surroundings must be such as to force all of the gas and other products of oil decomposition to penetrate the arc stream throughout its entire length. Recent investigations indicate that when these conditions are fulfilled the rate of recovery of dielectric strength in the arc stream after a zero current will be adequate to cope successfully with the rate at which recovery voltage may build up across the arc terminals under any circuit conditions to be found in practical service. It was in an endeavor to meet these requirements for more effective arc extinction—in other words, to make more efficient use of the oil in arc rupture—that the Deïon grids were developed.

The arc is drawn between the parting contacts in a vertical, relatively narrow, deep groove formed by slots in the several plate elements of the grid and closed at the outer end. Plates of magnetic materials spaced at intervals throughout the grid and so arranged as to form a partial return circuit provide a magnetic field when an arc is drawn through the air gap which is a part of the groove. This magnetic field operates to move the arc steadily toward the closed end of the groove. If the grid is submerged in oil the groove is filled with oil, which cannot escape except through the small openings at the top and bottom and which for the short interval of time that the arc exists is for all practical purposes solidly entrapped. Furthermore, the groove is very narrow and the arc drawn longitudinally through it fills practically the entire open end of the groove.

It is apparent that an arc moving toward the closed end of the groove is in effect being forced against a solid wall of oil throughout its entire length, resulting in a high rate of decomposition of the oil with an accompanying continuous and adequate supply of fresh un-ionized gas. This gas cannot escape except through the arc stream since the arc fills the open end of the groove. Due to the driving power behind the arc, the gas is forced to pass through the arc stream, diluting it with small volumes of un-ionized gas, while current is



Typical test shows 1,200 amp. arc extinguished in 4.5 cycles

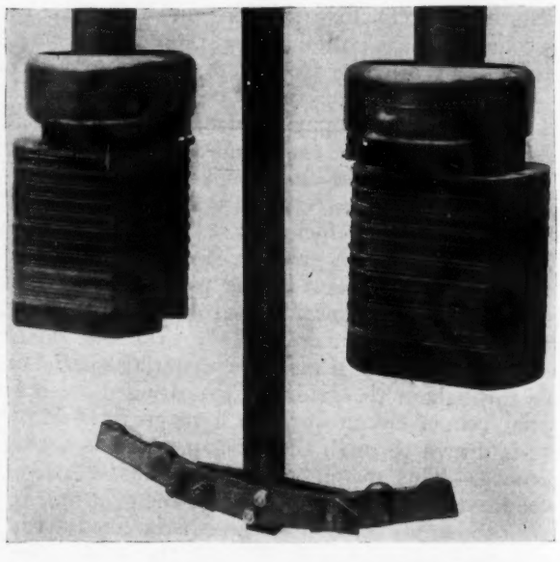
With the use of Deïon grids circuit interruption within 10 to 12 cycles of short circuit should be obtained consistently at the higher transmission voltages with the conventional mechanical design now supplied in breakers for this class of service. Interruption within 7 to 8 cycles of short circuit in the same class of voltages seems to be quite feasible at a moderate increase in cost of the breaker. Breakers designed for speeds of operation higher than this require careful attention in design and manufacture with the use of high-grade materials and the cost must necessarily increase rapidly as the period of short-circuit duration is decreased.

The efficiency of rupturing performance of an oil circuit breaker, or the rate at which the arc stream regains its dielectric strength after the current zero, is directly proportional to the effectiveness of the means for preventing the escape of gases generated in the vicinity of the arc without passing through the arc stream.

flowing, which act as de-ionizing surfaces after the current zero is reached. An additional de-ionizing effect is obtained from the sides of the groove where the arc impinges as it moves. The insulating plate elements in the grid are of absorbent material, containing in their submerged condition considerable oil content. As the arc passes over the edges of these grid plates, exposed in the sides of the groove, the heat forces this material to give off its oil, which is also volatilized and thrown turbulently into the arc stream. This characteristic of giving off oil and creating a gas film along the sides of the plate elements also serves to protect them from burning under the heat of the arc.

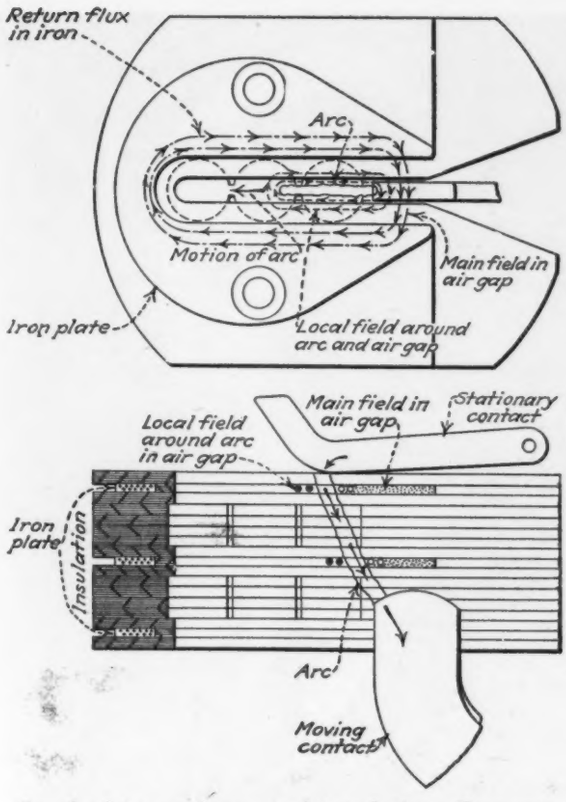
The results of upward of 2,000 short-circuit tests with currents ranging from 20 amp. to 1,500 amp. and at voltages of 13,000 to 176,000 r.m.s. across a single pair of contacts have demonstrated the effectiveness of the Deïon grids as a means of making more efficient use of the oil in arc rupture. Consistent rupturing performance of from 60,000 to 100,000 r.m.s. recovery volts across a single pair of contacts has been obtained in from 5 to 6 in. of contact separation on a circuit in which "overshooting" up to 100 per cent above nominal recovery voltage is a common occurrence. A series of fifty rupturing tests has been made on a field circuit with current values ranging from 1,000 to 7,000 amp. and with 42,000 r.m.s. recovery volts across a single pair of contacts, the oil at the end of the series showing only a slight diminution in dielectric test and being ready for further interrupting duty without any maintenance work. The arc energy dissipated is reduced to a fraction of that obtained with the hitherto conventional form of circuit breaker and internal pressures are reduced to such an extent that on a majority of the tests made with one breaker in the development of this device only half the tank bolts and cover plate bolts were in place.

The important thing in applying a gas blast for the extinction of an arc is to make sure that the blast enters turbulently over the whole section of the arc stream. This is best done by making the blast pass longitudinally through the arc space. If a perpendicular blast is used, then the arc is merely carried along with the blast without mixing and the only effect is the lengthening of the arc if its terminals are fixed. If the arc is stopped by



Contact mechanism of Deïon grid breaker

The current-carrying contacts are of the plain butt contact type, the movable member being rigid and of light construction adapted to high-speed operation. Interrupting elements or stacks of grid plates are supported by means of stationary contact elements.



Stacked iron plates and insulating elements form Deïon grids

When contacts part on opening of breaker an arc is drawn in the narrow groove, giving rise to a magneto-motive force in the iron circuits and across the air gap of one turn times the current in the arc.

coming against some barrier or "arc splitter," then the blast becomes longitudinal and effective.

The oil circuit breaker is a gas blast switch, points out Dr. Slepian, the gas blast arising from the decomposing oil. From this point of view the decomposition of the oil, instead of being entirely undesirable, is the very feature which makes the oil breaker function. To improve the oil breaker the rate of formation of gas should be increased, not decreased, provided of course that the gas formed is thoroughly mixed with the ionized gas which is carrying the arc. As a matter of fact, liquids more volatile than the usual switch oils are used quite successfully in certain types of fuses.

In the oil circuit breaker the attempt should be made to cause the oil to be decomposed at as rapid a rate as possible and to cause the gases formed to pass turbulently over the whole section of the arc stream. In this way the length of the arc for a given voltage will be reduced and the arcing time lessened, so that in spite of the increased rate of gas evolution per unit time and per unit length of arc the total amount of gas generated in a particular switching operation will be lessened.

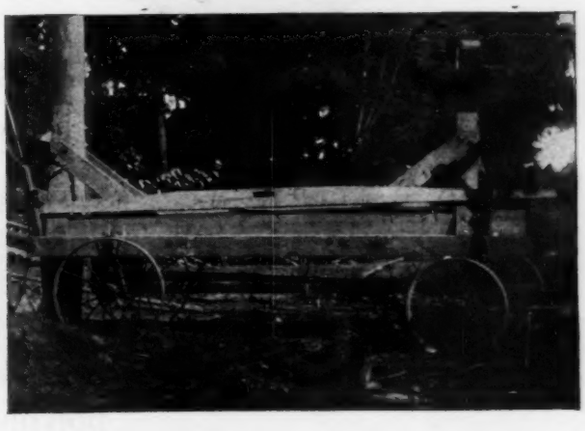
The growth of the gas bubble in the oil breaker is a factor which works against the extinction of the arc, because clearly it causes the oil boundary to be at a considerable distance for most of the arc section, and therefore causes the rate of decomposition of the oil to be reduced. It is well known that a so-called "blowout" magnetic field in an oil circuit breaker causes the volts per centimeter which can be interrupted to be greatly increased, and it is usually assumed that in the air magnetic blowout switch the effect of the field is to bend the arc out to a greater length. However, calculation shows that the forces involved in the time available can move the arc only a short distance in so dense a fluid as oil, and direct observation fails to show any bowing out of the arc-containing bubble. It seems more likely that the effect of the field is to cause the arc to be displaced in the bubble itself, so that instead of the greatest current density being in the center of the bubble it is driven to one side close up against the oil wall. This causes a greatly increased rate of gas formation, which mixes with the ionized gas and at current zero accelerates the arc extinction.

▼ ▼ ▼

Gin Pole Wagon Raises Poles in Rough Country

FROM 34 to 38 50-ft. to 70-ft. poles per day are erected in rough country in Virginia by the use of a gin pole wagon which can be used wherever a pair of mules, horses or oxen can haul this vehicle, according to A. W. Davenport, resident engineer Stone & Webster Engineering Corporation, Richmond Va. This device, which is useful in many places inaccessible to an automobile truck or tractor, is made up from an ordinary farm wagon, with rough lumber, some carriage bolts, a 40-ft. pole and block and tackle. The wagon is provided with bracing which carries the gin pole in a horizontal position when in transit and supports it in the vertical position with base on the ground during pole erection, triple guying being employed in the field.

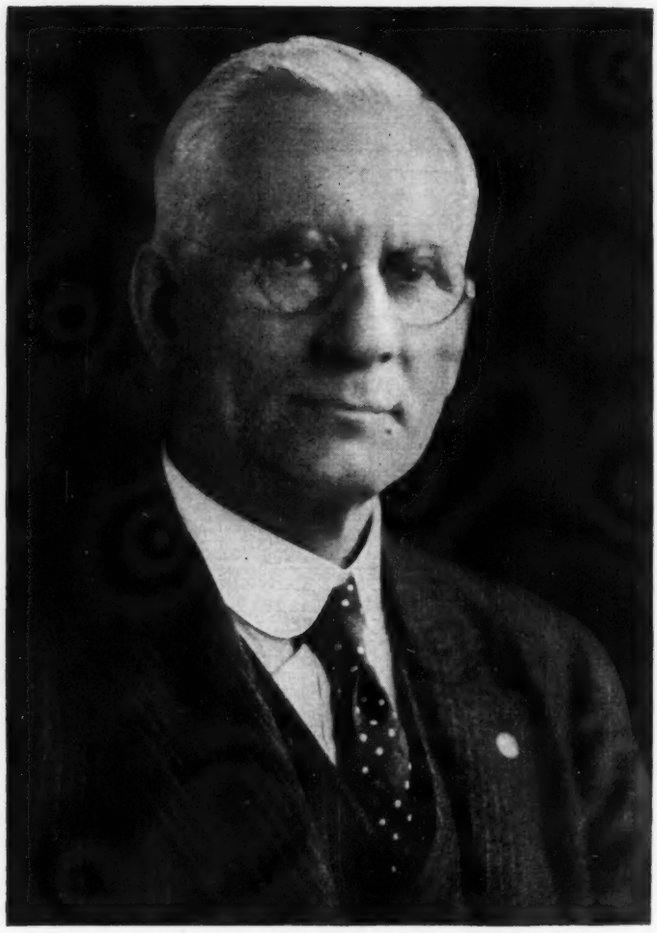
Raising pole by tackle and portable gin stick



EDISON AWARD

to

C. F. Scott



THE Edison Medal is awarded by the American Institute of Electrical Engineers for "meritorious achievement in electrical science, electrical engineering, or the electrical arts." This year it goes to Professor Scott of Yale "for his contributions to the science and art of polyphase transmission of electrical energy."

LIGHTNING LESS MYSTERIOUS

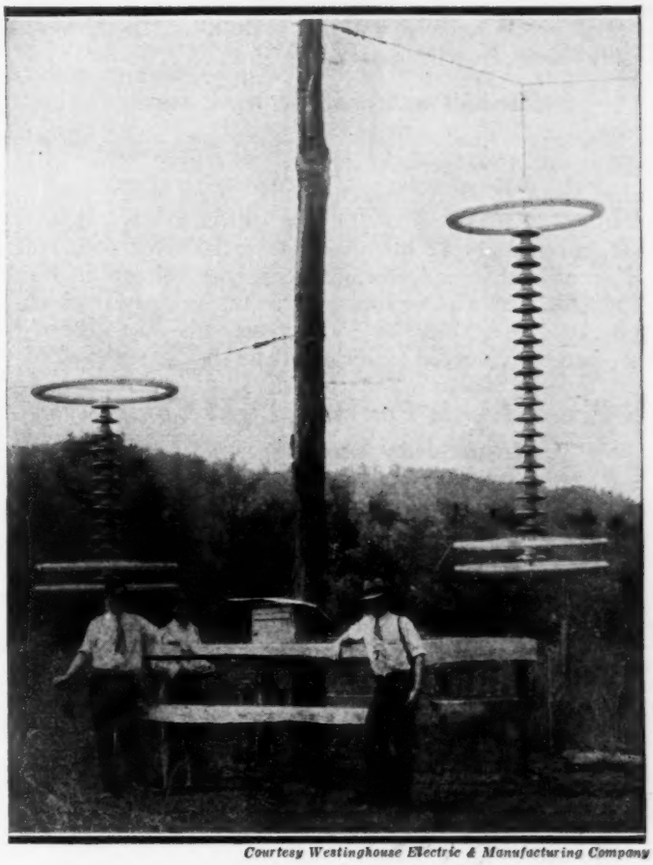
Two direct strokes recorded as negative.

Line surges are predominantly positive and therefore of induced origin.

Gradients as high as 52 kv. per foot of tower height.

Ground wires reduce the induced potential and trip-outs but also reduce attenuation.

Uniform low resistance of tower footings is superior to lumping of low resistances.



Courtesy Westinghouse Electric & Manufacturing Company

THE years 1926, 1927 and 1928 witnessed a vigorous attack on the subject of lightning and many long-standing questions found their answer, but fully as many were left unanswered or in controversial status. The lightning season of 1929, just reported upon at the winter convention of the A.I.E.E. in New York, developed the answer to the bulk of the previously unanswered items and a notable amount of clarity in our conceptions of the lightning problem has been established. The great stride forward was made possible by the development of such new instruments of attack as the lightning stroke recorder, field intensity recorder, rate-of-change-of-field-intensity recorder and single-sweep time axis for the cathode-ray oscillograph. But the greatest factor was the firm determination to solve the problem and therefore to organize as effectively as possible for the attack. The extent of the investigation and of participation in it is manifest from a glance at the list of papers and the connections of the authors.*

One pair of investigators[6] found crest voltages as high as 1,640 kv. on one system and 2,700 kv. on another, both values representing about fifteen times normal voltage of line wire to neutral. The corresponding values per foot of tower height ranged from 20 to 52 kv. per foot. On special antennas used in connection with the field-intensity recorder a potential gradient of 85.5 kv. per foot was measured. This is a near approach to the value of 100 kv. per foot commonly assumed as the worst possible gradient. It is likely that the limit to the gradient on the transmission line is set by the flashover value of the line insulators and that this gradient will increase as line insulation is increased. Klydonograph stations were installed[1] 10 and 20 ft. above the earth, one of each height installed on a mountain top and one of each in a valley. The maximum gradient recorded at any station was 20 kv. per foot and this appeared uniform as the gradient indicated by the high and the low antennas was the same.

The maximum crest value of any pure lightning surge found on another line[5] was 8.4 times normal and positive. The maximum voltage recorded on combined lightning and switching surges—that is, where a trip-out occurred—was 14.3 times normal (108 kv.) and negative with a positive indication for this same surge of 7.1 times normal, occurring at the same place where the negative was noted. Out of 31 lightning surges, about 25 per cent were above 4.5 times normal, 10 per cent above six times normal, 6.5 per cent above eight times normal and 3 per cent (one surge) above fourteen times normal. On the other hand, under switching con-

**See list of authors on page 258. References throughout this article refer to this list.*

ditions, the maximum value of surge recorded was 4.9 times normal on de-energizing the line and 2.7 times normal on energizing the line. Both of these were highly damped oscillations.

One-half microsecond wave front

The wave fronts in one set[1] of observations varied from 2 to 10 microseconds, the durations above half value from 0 to 75 microseconds. One surge had a wave front steepness of 143 kv. per microsecond and at approximately 12 microseconds a flashover occurred on an adjacent conductor, reducing the voltage on the conductor under observation to 1,000 kv., after which it decayed to 600 kv. at 55 microseconds. In general, the surges recorded indicate that the lower valued surges are shorter in duration than those of higher values. This year's experience fortifies the earlier conclusion that those surges which have voltages and durations high enough to be dangerous on high-voltage lines are caused by direct strokes and that induced strokes are innocuous, except perhaps on the lower voltage distribution circuits such as distribution lines.

Pennsylvania Power & Light Company Cathode-Ray Oscillograms Over 300 Kv., Year 1929

Oscillogram Number	Kv., Max.	Polarity of First Loop	Nature of Wave	—Time in Microseconds to Reach— Max. Voltage Recorded	50 Per Cent Max. on Tail of Wave	Zero of First Loop
901180	1260	Neg.	Osc.	3.3	3.7	4 Flashover
185	360	Pos.	Uni.	4	45 +	45 +
186	330	Pos.	Osc.	1.6	16	29
188	530	Pos.	Osc.	7–8	18	24
191	600	Neg.	Uni.	4	14.5	45 +
193	740	Pos.	Osc.	7	16	22
194	810	Neg.	Osc.	36	?	37 Flashover
201	740	Neg.	Uni.	6.5	43 +	43 +
229	330	Neg.	Uni.	?	12	75
231	330	Pos.	Osc.	?	18	25
249	390	Pos.	Osc.	6	14	18
251	390	Pos.	Osc.	6	35	55
272	600	Neg.	Uni.	< 7.5	69 +	69 +
275	.00	Pos.	Osc.	< 8	32	45
285	630	Pos.	Osc.	11	20	29

Osc. = Oscillatory. Uni. = Unidirectional.

Other oscillograms[5] revealed waves in which the time to reach 75 per cent of maximum voltage varied from ¼ microsecond for the fastest waves to 13 microseconds for the slowest waves, while the total front of the waves varied from 1 to 30 microseconds. The length of the waves, to half maximum value on the tail, varied from 12 microseconds to 52 microseconds, while the total length of the waves, to zero, varied from 48 microseconds to approximately 95 microseconds. All these were positive and of relatively low voltage. It would appear that they were induced voltage surges rather than surges resulting from direct strokes. Furthermore, the surge voltage recorders indicated no simultaneous high voltages, the lightning stroke recorders no simultaneous direct hits, and no accompanying trip-outs occurred.

An analysis[6] of 95 surges showed there were 50 surges under 100 kv., 30 between 100 kv. and 300 kv. and fifteen over 300 kv. One oscillogram obtained in 1928 was positive in polarity, rose to maximum in 8 microseconds, reduced to 50 per cent of that value in 17 microseconds and to zero in 35 microseconds. The crest voltage of the main wave was approximately 600 kv. At a point 17 miles from the laboratory a value of 2,100 kv. was recorded by the surge voltage recorder.

The accompanying table summarizes the data for the fifteen oscillograms with voltage magnitude exceeding 300 kv.

Two direct strokes were negative

Two direct strokes were indicated by lightning stroke recorders.[5] In one it was determined that the cloud was negative and that a current of approximately 175,000 amp. had flowed down the tower during the stroke. This was the first (July 25, 1929) record ever obtained of a stroke which was actually known to have struck a transmission line. A positive voltage surge was released on the line. The surge voltage recorded at the tower struck, measured a maximum voltage of 8.4 times normal (positive) and it may have been higher. The surge attenuated rapidly on each side of the tower and after 5 miles was not further indicated by the surge voltage recorders. No trip-out occurred. Another record of direct stroke was obtained on August 23. A negative voltage of 6.5 times normal was recorded by the surge recorder at the same tower, while a positive voltage of 3.5 times normal was recorded at a tower 1 mile away. The line tripped out and voltage was immediately restored to the line without difficulty. A lightning current in the tower of approximately 100,000 amp. was estimated.

In another study[6] there were 284 stroke recorders placed in service on as many towers in lines comprising 320 towers total. Four records were obtained. One was interpreted to represent about 60,000 amp. negative polarity. At the same time the surge voltage recorder at this tower indicated a positive surge of 2,400-2,800 kv. (13.3 to 15.5 times normal). Another was interpreted to indicate about 100,000 amp. negative polarity. The third, in Ohio, indicated approximately 175,000 amp. negative polarity, at the same time the surge voltage recorder on the transmission conductor on this tower indicated a positive surge of 8.4 times normal. The fourth showed 100,000 amp. and 6.5 times normal and a trip-out resulting.

Attenuation less for negative impulses

Two lightning surges of relatively high magnitude were recorded on the instruments located on a 16-mile attenuation set-up[5]. One surge had a maximum value of 8.4 times normal positive and the other a maximum value of 14.3 times normal negative. A very marked difference was noted in the rate of attenuation of the positive and negative surges, the positive surge attenuating considerably faster than the negative. Thus, whereas the positive surge at 8.3 times normal potential attenuates to 50 per cent of its value in 1.3 miles, it takes the negative surge 2.75 miles to reach a corresponding attenuation.

During the season surges from the 1,000,000-volt field lightning generator were placed on one of the three phases of one line[5] separately and in various combina-

[1] [5] [6] *See page 258.*

tions and the magnitude of the crest voltage measured from Lichtenberg figures obtained from the surge recorders. The higher rate of voltage attenuation with the surge energy supplied to the three line wires instead of one was found in these tests as in the case cited above. Also a distinct difference was found in the rate of attenuation of positive and negative surges; for example, with a positive surge of 500-kv. crest the value dropped to 200 kv. in 9 miles when applied to one wire only; from 500 kv. to 200 kv. in 6 miles if applied to two wires, and from 500 kv. to 200 kv. in 5 miles when applied to all three line wires. When the surge was negative the same relative difference in the rate of attenuation with one, two and three wires appears, the drop from 550 to 250 kv. occurring in 8½, 4¾ and 4½ miles respectively.

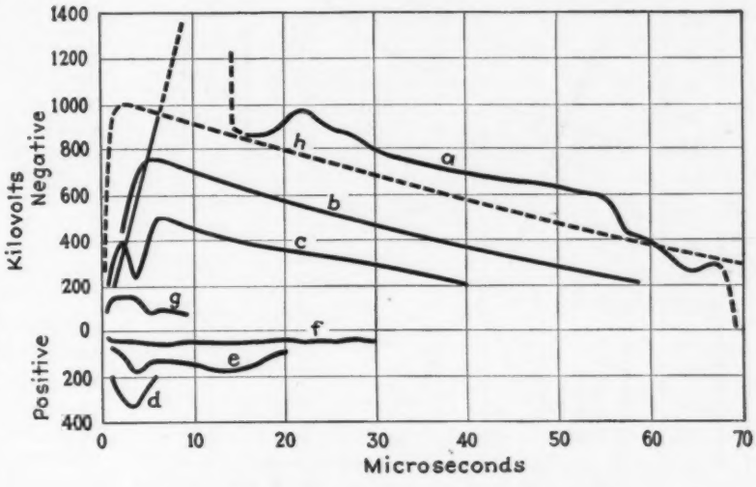
Lightning arrester discharges 226 amp. at 450 kv.

A lightning arrester surge recorder set-up[5] yielded 53 surge records. In most cases a correlating voltage at the terminals of the lightning arrester was obtained, where current discharges through the arrester were recorded. A lightning arrester discharged a current of 226 amp. per leg at 450 kv. Since it is known that switching surges do not exceed some 550 kv. on these lines, there is no definite data to show that the arrester has held the voltage down appreciably on switching surges. A point definitely in its favor is that it has handled 226 amp. at 450 kv. Of course this would not affect its economic justification if the system apparatus is built to withstand an indefinite number of surges of switching origin and magnitude without failure. The maximum lightning voltage surge on the arrester recorded 380 kv. with a corresponding current of 105 amp. There are no data, however, to show how much the discharging current of 105 amp. helped to bring down the lightning voltage which might have existed without the arrester, or how much the arrester aided in holding down the voltage to 380 kv.

An antenna 50 ft. from the ground with a grounded conductor 10 ft. above during a lightning stroke[6] registered a potential approximately one-half that recorded on a similar 50-ft. antenna without ground wire.

Three surge voltage recorders were installed[2] several miles from an oscillograph station and so arranged that one recorded voltage between line and tower, another voltage between line and ground and a third between tower and ground. This was done to ascertain the distribution of voltage between those parts when the line was subjected to lightning voltages. Theoretically it appears that the voltage between line and ground should equal the sum of the voltages from line to tower and from tower to ground. On lines equipped with ground wires there is a tendency for the towers to be raised to high voltage due to the charges induced on the ground wire. On towers whose footings rest in sandy or rocky soil of high resistance the tower-to-ground voltage may be very high and may possibly be the same order of magnitude as the line-to-tower voltage to which the insulators are subjected. With towers having no ground wire but a low footing resistance (3 ohms) due to a marshy location, the tower-to-ground voltages were of the order of 3 to 6.8 kv., with surges that made the line-to-tower voltages range from 650 to 1,500 kv. and the line-to-ground voltages 520 to 650 kv.

On the other hand, a tower set in sandy soil and having a footing resistance of 1,150 ohms carried a ground wire but disclosed tower-to-ground voltage as high as 140 kv. with a surge that rose to 1,070 kv. line-to-ground and established a 675 kv. potential line-to-tower. These voltages are of surprisingly high magnitude and demonstrate the necessity of auxiliary grounds on towers whose footings are of high resistance. From both the standpoint of electrical operation and the standpoint of safety tower resistances should be carefully checked, particularly on lines provided with ground wires.



Typical lightning surges recorded with cathode-ray oscillograph

(Cox & Beck)

Surge	Polarity	Rate of Rise Kv. per Microsecond	Crest Kv.	Time to Reach Crest	Time to Reach Half Crest	Locality
a.	Neg.	143	1000+	7	..	New Jersey
b.	Neg.	183	750	5	33	Tennessee
c.	Neg.	270	550	6	26	New Jersey
d.	Pos.	137	325	3	4	New Jersey
e.	Pos.	30	180	5	15	W. Virginia
f.	Pos.	...	45	..	30	New Jersey
g.	Neg.	167	160	2.5	8	W. Virginia
h.	Pos.	500	1000	2	43	Trafford Lab.

A joint investigation[3] was carried out to determine attenuation characteristics with one, two and three conductors subjected to surge in parallel and the effect with and without ground wire.

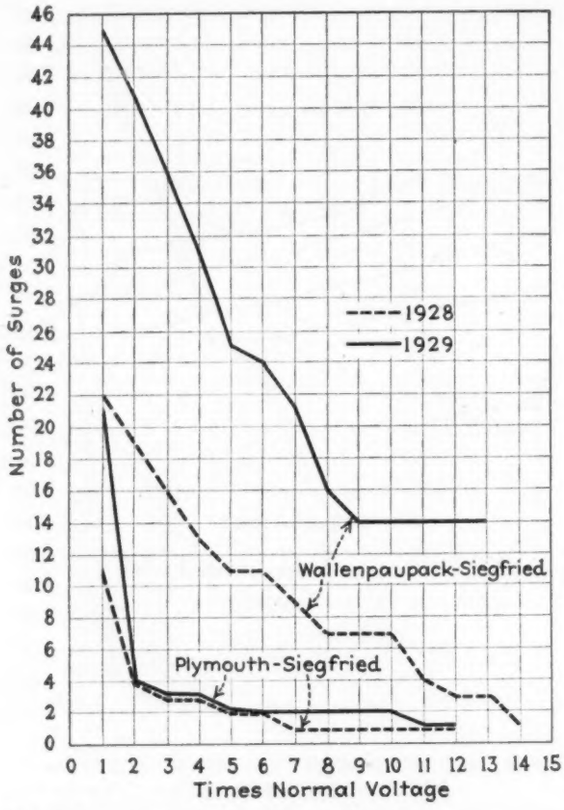
Parallel conductors propagate surge

When a surge is traveling on a number of conductors in parallel, as is always the case on an actual transmission line, the capacity to earth is reduced by the presence of surges of the same sign on the other conductors. Thus the charge on each conductor at a given surge voltage is less, and so the potential gradient, and consequently the corona, is less on each conductor than would be the case with a single conductor. Following out this line of reasoning, one would expect to find the attenuation less

2 3 5 6 *See page 258.*

when several conductors in parallel were carrying the same surge. The tests made show conclusively that increasing the number of conductors in parallel does decrease the attenuation.

With dissimilar electrodes, as in a pin type insulator, flashover will take place at a lower potential when the cap is positive than when negative, although as the rate of potential application is increased the positive and nega-



Number and crest values of lightning surges on Wallenpaupack-Siegfried and Plymouth-Siegfried lines

(Smeloff & Price)

tive spark potentials approach a common value. Thus one would expect that a difference would exist in the corona loss for positive and negative impulses and that in general the loss for the positive impulse would be greater. On this basis the attenuation with negative impulse should be less than for the positive impulse, which was in general found to be true. It is reasonable to expect that with extremely short waves positive and negative attenuation would be equal. The only tests made with short waves were made with a chopped wave having a 7-microsecond front, which was probably much too long to give equal values of attenuation for positive and negative surges.

The tests made have shown that attenuation is dependent on wave shape. The state of breakdown of the air in the corona area around a conductor is changing very rapidly during the passage of a surge and consequently the attenuation varies on different parts of the surge. Thus if the corona loss was greatest during the initial stages of breakdown a short wave would suffer more attenuation than a long wave.

With a traveling wave the ground wire takes up a charge of opposite sign to that of the wave in the line conductor and this results in an increased charge on the line conductors, which results in an increased corona loss at a given potential. This effect tends to increase the attenuation. On the other hand, the increase in charge results in an increase of energy of the surge, which tends to decrease the attenuation. It has formerly been assumed that the resultant effect of the ground wire is to increase the attenuation, but the attenuation was found to be less with the ground wire, especially in the case of the negative impulse on the line conductor. Apparently the increases in surge energy and corona loss are more or less balanced in the case of the positive impulse, but with the negative surge the increase in surge energy seems to be greater than the increase in corona loss, resulting in a decreased attenuation.

Artificial surges travel farthest on multiple conductors

The attenuation tests[3] with slow wave extended over a distance of 30 miles from the impulse generator. The results with a single conductor show that the negative impulse has decreased from 475 kv. to 90 kv. and the positive from 415 kv. to 60 kv. as a result of traveling 30 miles. The chopped wave gave results which indicate that the change of potential in the free wire with distance is very small and approaches the potential of the conductors carrying the original surge.

When the surge was applied to the bottom conductor the top conductor assumed an initial potential of about 30 per cent of the applied. This increased to 50 per cent when the impulse was applied to the middle and bottom conductor in parallel. The potential of the free wire and of the conductors carrying the surge all come to the same value in a distance of 5.7 miles. Also, it was evident that the attenuation is greater with a single conductor than with simultaneous surges on multiple conductors, although this effect was more pronounced with the chopped wave than with the others.

The attenuation with the positive impulse seems to be only slightly affected by the presence of one or two ground wires, although the tendency seems to be definite at potentials above 200 kv. for a decreased attenuation with ground wires. Expressed in distance of travel to suffer the same reduction in potential, the positive impulse without ground wires traveled 5.8 miles to reduce from 360 kv. to 190 kv., while with one ground wire the corresponding distance was 6.8 miles and with two ground wires the distance was 7 miles.

With negative impulses of a potential of the order used in these tests the attenuation was considerably decreased by the presence of ground wires. To illustrate, without ground wires the potential decreased from 380 kv. to 180 kv. in a distance of 7.4 miles, while with one ground wire the distance required for the same decrease was 14 miles and with two ground wires the distance was of the order of 15 miles.

The idea that ground wires should damp out traveling waves quickly does not seem to hold; in fact, the tests show that the reverse is true. This does not mean that

[3] *See page 258.*

ground wires are not useful in reducing the potential which would otherwise have been present when the line is under a discharging cloud, nor does it mean that the ground wire would not be helpful in case of a direct stroke of lightning to the ground wire or line wires.

It is the function of the ground wires to reduce the potential appearing on the line conductors just after the lightning discharge takes place but before the charges begin to travel along the line wires. The mechanism of this reduction is frequently divided into two parts, which will be referred to as the first and second effects of the ground wire. The first effect is that which arises from the discharge of the ground wire, resulting in an increase in capacity of the line wires and, with the fixed amount of charge on them, a decrease in their potential. The second effect, smaller than the first, results from a further increase in capacity of the line conductors as the ground wires take up charges of the opposite sign. The total effect of ground wires in reducing the potential on the line conductors during the release of a bound charge is the sum of the first and second effects. The sum of the first and second effects gave a total reduction of 28 per cent for one ground wire. With two ground wires the first effect is increased. The tests indicated that the second effect is not materially changed when two are used instead of one. They also showed that ground wires on a transmission line under a discharging cloud afford somewhat better protection than is indicated by the usual theoretical formula.

Ground resistance should be uniform throughout

If two resistances equal to one-eighth of the surge impedance are connected between line and ground farther apart than half the wave length only 4 per cent of the wave is transmitted, while if the same two resistances are connected at the same point the transmitted wave will be 11 per cent. This does not mean that it is better to ground a ground wire at a few points far apart rather than many points close together, but it does indicate that two grounds of 50 ohms each are better if separated some distance apart than one ground of half the resistance in one location. This seems to indicate the desirability of keeping the ground resistance of towers uniformly as low as possible rather than having wide variations in tower footing resistance, even though some are low, but with a high average.

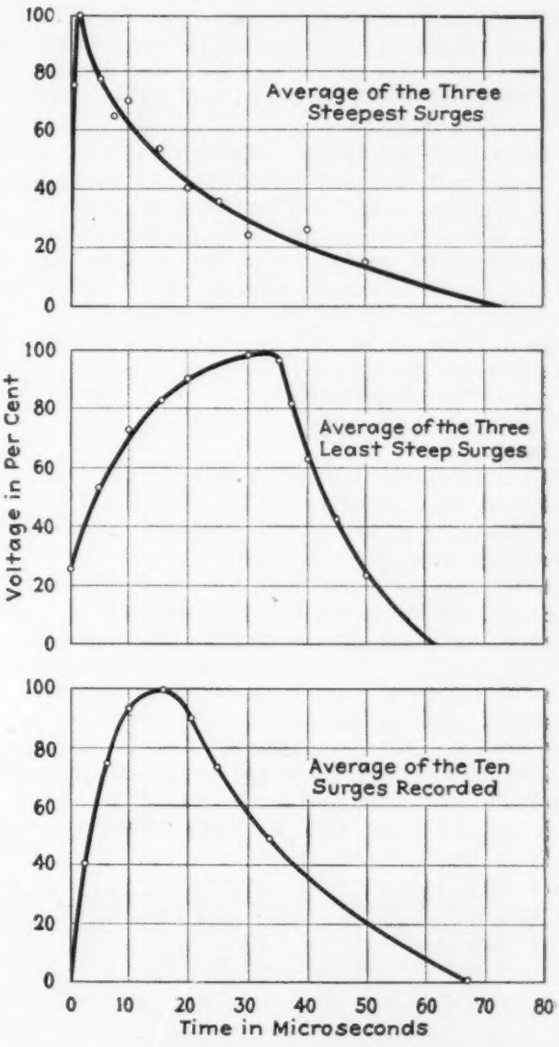
The outstanding results

The amount of progress made in advancing our understanding of lightning can be sensed from the many conclusions arrived at in the various papers. Many of these are comprehensive answers to questions which had been hampering developments and many of them controvert theories more or less tacitly accepted before last week's session. Several matters are to be the subject of continued study to realize on the momentum gained in the work of the 1929 lightning season:

1. About 115 cathode-ray oscillograms of natural lightning were obtained on three different systems,[6] ranging from low values to 1,260 kv.

2. Two direct strokes were recorded.[5] Both were of negative polarity (negative cloud). Currents of 175,000 amp. and 100,000 amp. were measured in the towers. Induced voltages were simultaneously recorded on the phase conductors. Only one, however, produced a dynamic trip-out of the line. The potential of this induced voltage surge attenuated rapidly and in accordance with the Foust and Menger formula.

3. Ten cathode-ray oscillograms of induced natural lightning surges were obtained.[5] All were of low voltage and of positive potential.



Wave fronts of lightning surges

Average of the three steepest, of the three least abrupt and of all ten surges, all positive
(Sporn & Lloyd)

4. The lightning surges on the system are predominantly positive, indicating that they come from induced surges and are not direct strokes.[5] The maximum positive lightning surge recorded[5] was 8.4 times normal; the maximum[6] negative surge recorded was 15.2 times normal; the maximum[5] de-energizing switching surge was 4.9 times normal, and the maximum energizing surge was 2.7 times normal.

5. Gradients as high as 52 kv. per foot of height have been recorded[6] on transmission lines and 85 kv. per foot on special antennas.

6. Trip-outs have occurred on the lines under investi-

[5] [6] *See page 258.*

gation[6] as high as 29 per 100 miles per year, with 3.6 flashed insulator assemblies per trip-out.

7. Of the ten[5] oscillograms of natural lightning obtained three were of steep wave front (0.5 microsecond or less to 75 per cent of maximum voltage); four were of slow wave front (4 to 8 microseconds to 75 per cent); three of very slow front (10 to 13 microseconds). Since a slanting wave front results from a slow cloud discharge and a slow cloud discharge cannot produce a high induced voltage, it is not surprising that these low-voltage surges included seven having relatively slow fronts. The three steep-fronted surges were also of low voltage, in spite of the rapid cloud discharge, being probably the result of the discharge of a distant rather than of a near cloud.

The average of the three steepest waves probably represents a type that is most likely to reach high enough voltages to cause spark-overs on high-voltage lines.

8. Data were obtained[5] showing that a direct stroke can result in line outage; that it is possible for a direct stroke to cause no line outage, and that it is possible to have a direct stroke away from the line result in an outage on the transmission line.

9. Unidirectional waves are more common than oscillatory.[6]

10. Attenuation apparently[6] varies with the size of conductor, with the steepness of wave front, with the polarity of the wave, with the presence or absence of ground wires and possibly other factors.

11. For positive impulses the ground wires have but little effect on the attenuation.[3] In the case of negative impulses it appears that the presence of one ground wire so decreases the attenuation that the impulse may travel twice as far with the ground wire as without. Two grounded wires increase this effect slightly. The idea that ground wires should damp out traveling waves quickly does not seem to hold; in fact, the tests show that the reverse is true.

12. Surges[3] attenuate less rapidly when other nearby parallel conductors are carrying similar surges. In general, positive surges attenuate more rapidly than do negative surges, although in some tests but little difference was found.

13. Short waves, such as a wave chopped on the front by an insulator flashover, attenuate[3] more rapidly than do longer waves of the same crest value.

14. The presence of the ground wire reduces the attenuation considerably for the negative wave and to a lesser degree for the positive impulse. This decrease in attenuation is important if found to be universally true, for it tends to cancel the reduction of induced potential as a result of a discharging cloud after the resulting traveling wave travels a distance of several miles. This, of course, does not affect the reduction in potential due to the ground wire at the point of inception.

15. The ground wire theory of reduction of induced potentials was checked,[3] using traveling waves. The results indicate a higher protective ratio for the ground wire than the usual calculation gives. For the conductor arrangement used, the calculated reduction was 15 per cent, while the test showed 20 per cent for the first ground wire effect.

16. The second of the ground wire effects was also checked[3] with traveling waves and it was found that when entering or leaving a section with one or two ground wires the surge voltage was decreased or increased 8 per cent respectively. These approximate the calculated value based on the change in surge impedance. These results indicate that very little is to be gained by putting up additional ground wires near a station to reduce an incoming impulse. From the standpoint of additional protection from lightning discharges which originate close to the station their use may be justified.

17. The total ground wire effect is the sum of the first and second effects and by test[3] was found to give a protective ratio of 72 per cent for the particular conductor arrangement used, while the calculated value is 79 per cent.

18. The value of overhead ground wires in reducing induced potential and in reducing trip-outs has been demonstrated by test and by operating experience.[6]

19. There is little difference between steel and copper conductors from the standpoint of their ability to transmit impulses.[3]

20. The theory of voltage reduction due to two resistances at varying distances apart connected between conductor and ground when subjected to traveling waves was checked by test.[3] The work shows that if but two grounds of equal value are to be used the greatest reduction in wave transmitted beyond the resistances occurs when the resistances are at least half a wave length apart. Uniform low resistance is preferable to widely varying resistances.

21. Transient ground resistance is less than the resistance measured under steady state conditions.

22. The surge impedance of a transmission line may be satisfactorily determined[3] from a series of voltage and current readings with varying values of resistance between line and ground.

For the future

Still more work is to be done on the differentiation between the surges and flashovers due to induced strokes and direct strokes. Attempts are to be made to record by cathode-ray oscillograph the wave shapes of some of the extremely high voltages which have been found by surge voltage recorded. The effects of counterpoises or grounded conductors under the transmission line will be studied. Attenuation will be given further study both with natural and artificial lightning. Devices to prevent flashover (line type arresters) will probably be tried out experimentally during the coming year.

A.I.E.E. Lightning Studies

**1. "Cathode-Ray Oscillograph Studies of Lightning," J. H. Cox and Edward Beck, Westinghouse Electric & Manufacturing Company.*

2. "Lightning Voltages on Transmission Lines," R. H. George, Purdue University, and J. R. Eaton, Consumers Power Company.

3. "Traveling Waves with Artificial Lightning Surges," K. B. McEachron and W. J. Rudge, General Electric Company, and J. G. Hemstreet, Consumers Power Company.

4. "Investigation on 220-Kv. System of Pennsylvania Power & Light Company," Nicholas N. Smeloff, Pennsylvania Power & Light Company, and A. L. Price, General Electric Company.

5. "Investigation on Ohio Power Company System," Philip Sporn, American Gas & Electric Company, and W. L. Lloyd, Jr., General Electric Company.

6. "Lightning Investigation on Transmission Lines," W. W. Lewis and C. M. Foust, General Electric Company.

7. "Lightning Laboratory at Stillwater," R. N. Conwell, Public Service Electric & Gas Company, and C. L. Fortescue, Westinghouse Electric & Manufacturing Company.

8. "Surge Characteristics of Insulators and Gaps," J. J. Torok, Westinghouse Electric & Manufacturing Company.

Selling Equipment to the Farmer

By K. R. MacKINNON
General Superintendent
Nebraska Power Company, Omaha, Neb.

CONCRETE evidence that the minimum bill is a potent factor in the sale of equipment to farm customers is furnished by an analysis recently made by the Nebraska Power Company. This company segregates its farm customers into two classes—the guarantee and the non-guarantee. They are similar in wealth and all other characteristics except in the length of line required to serve them and, therefore, in whether or not they pay a guaranteed annual minimum bill. The company operates in a comparatively small area to the west of Omaha, about 30 miles by 60, all of which has been taken over from smaller companies or municipalities during the past 2½ years. After the plan had been in effect about 1½ years a survey was made of those farms which had been on the line for a full year. The object was to find out which items of equipment the farmer was buying and to see what difference the guarantee made in his buying practices. The results of this survey are as shown in the accompanying cable.

From this it can be seen that both groups buy in equal numbers those items that the farmer's wife wants—namely, the washing machine, iron and water system. But the refrigerator, range, sweeper and other items that must be sold are bought much more freely by the guarantee customer. He has to pay from $7 to $12 per month anyway for service (according to the amount of his guarantee) and decides that he might as well get his money's worth, so he buys the equipment to use it. He also buys 300-watt lamps to light his farmyard and burns them freely. In fact, he electrifies his farm. For his $7 to $12 per month (the average is $10 per month) he gets from 65 to 190 kw.-hr. per month, and, being entitled to them, he starts out to use them. He buys equipment to get square with the company.

Electrical Equipment Used per 100 Farm Customers

	Guarantee Customers	Non-Guarantee Customers		Guarantee Customers	Non-Guarantee Customers
Washing machine	86	85	Hot plate	14	11
Iron	76	78	Range	14	2
Refrigerator	49	13	Machine shop	12	13
Vacuum cleaner	35	21	Space heater	12	2
Pump	30	28	Chore motor	12	2
Elevator	21	18	Brooder	5	3
Cream separator	21	14	Milk cooler	5	0
Water system	19	21	Water heater	2	0
Grinder	19	10	Oil burner	2	0

All customers in survey have been on lines a maximum of eighteen months and a minimum of twelve months.

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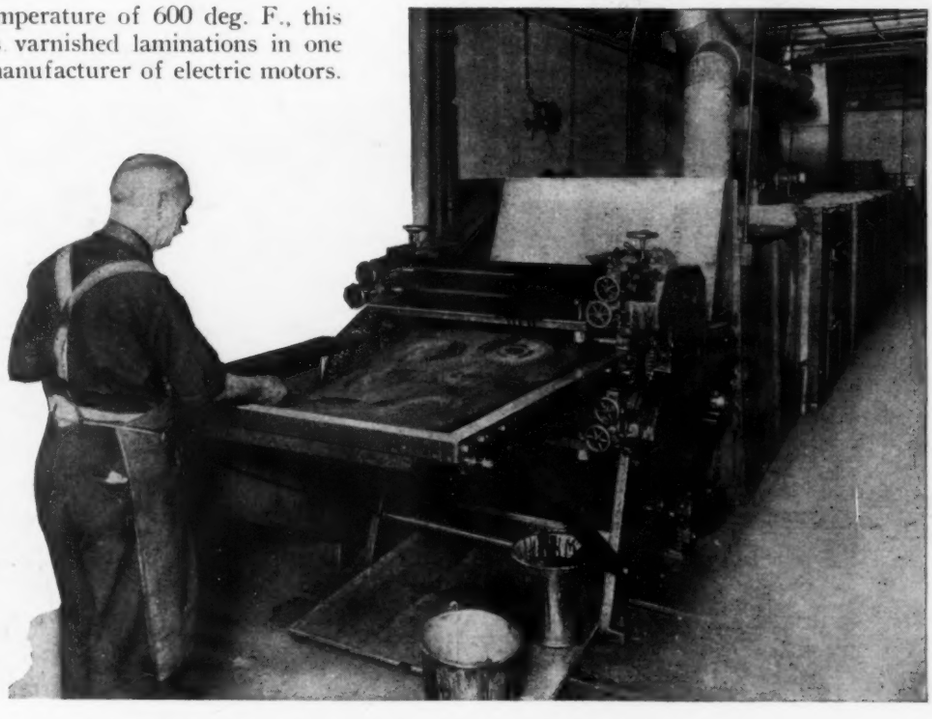
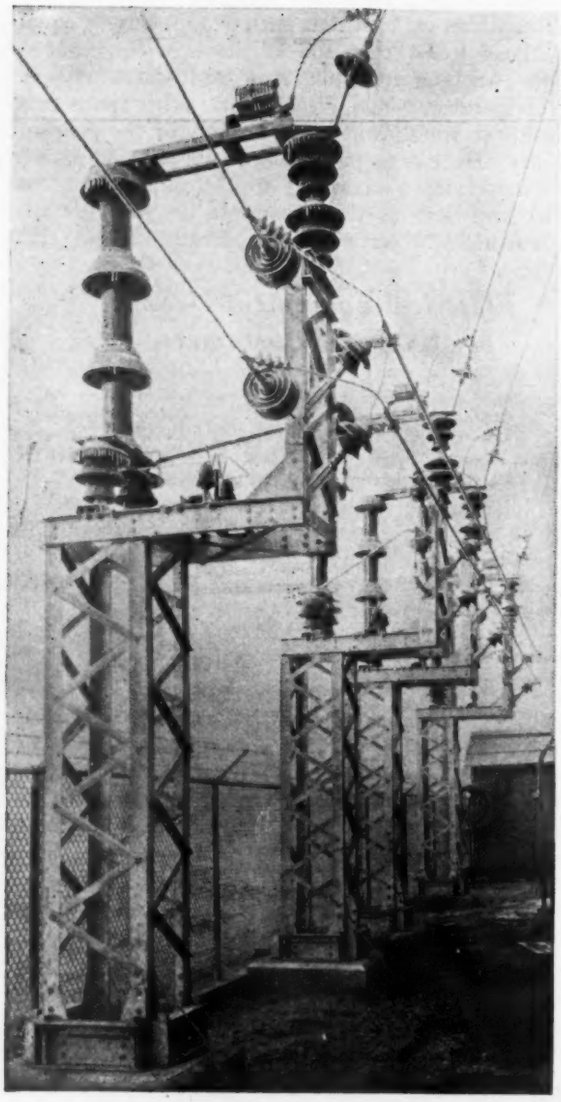
Rapid Lamination Baking by Electric Heat

OPERATING at a temperature of 600 deg. F., this Gehnrich oven bakes varnished laminations in one minute at the plant of a manufacturer of electric motors. Of particular interest is the material handling by means of a continuous spiral fabric wire belt supported on an all-steel roller type chain with heat-treated pins and cross flights. The oven is 25 ft. long, is equipped with the latest control indicating and ventilating elements and constitutes an important link in the production processes of the plant.

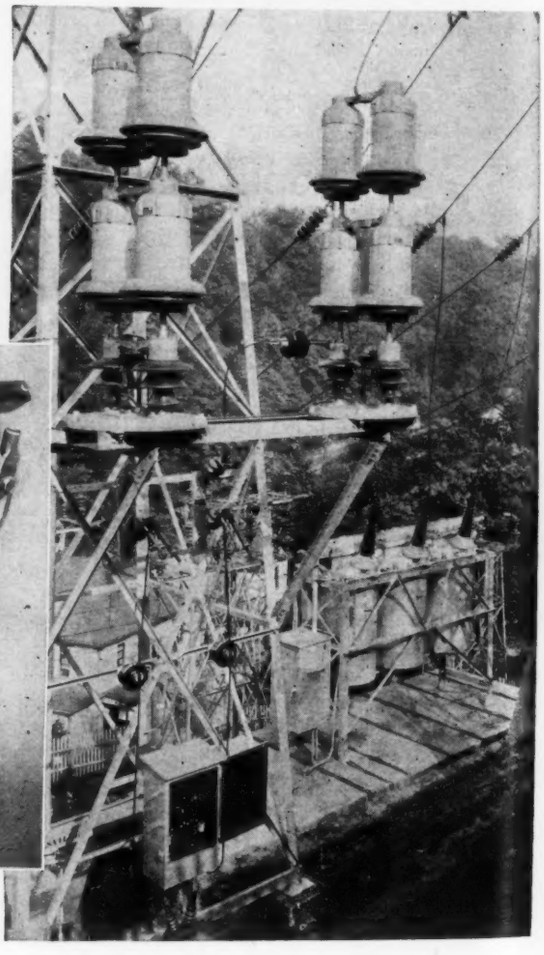


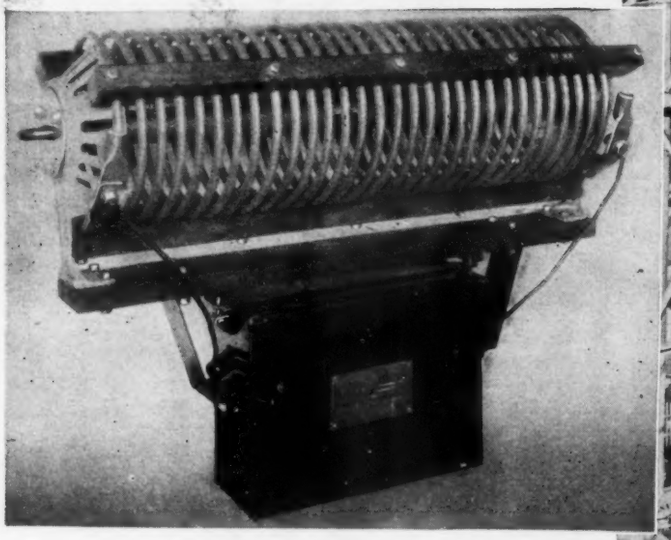
Five Types of Carrier Couplers Used on Ohio Power System



66-kv. mica capacitors at Crooksville

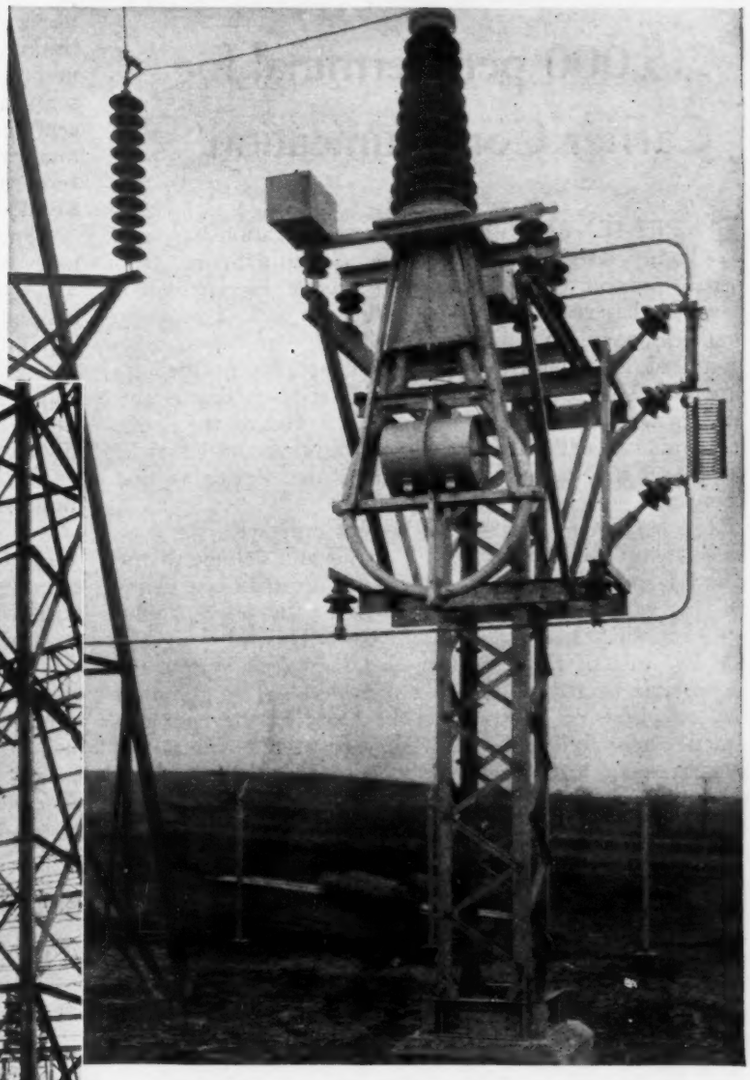
66-kv. dry-type porcelain capacitors at Steubenville

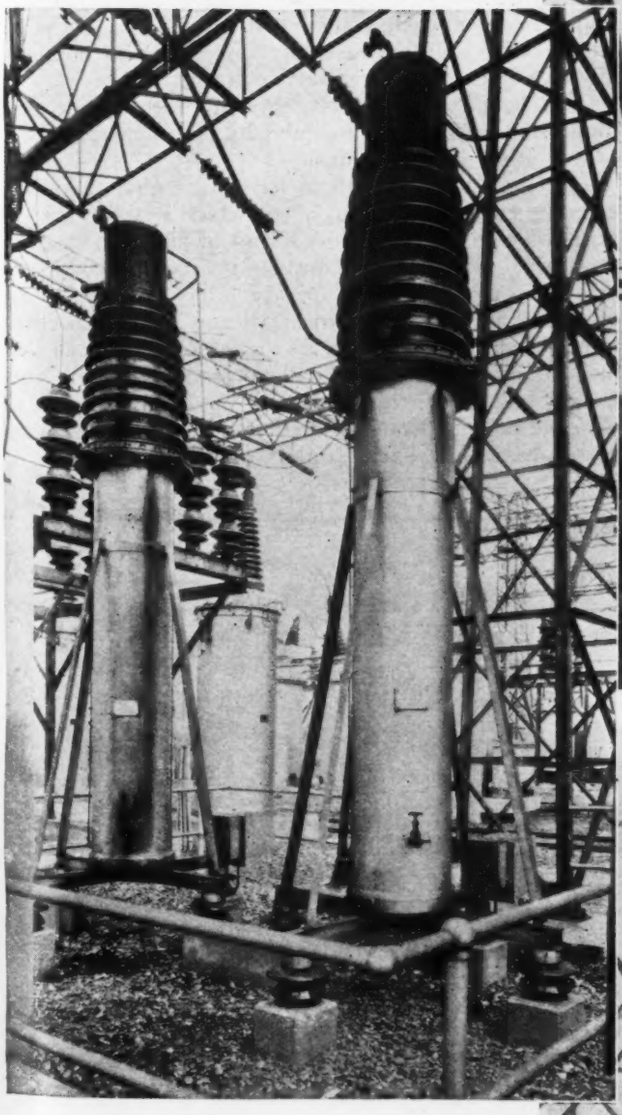


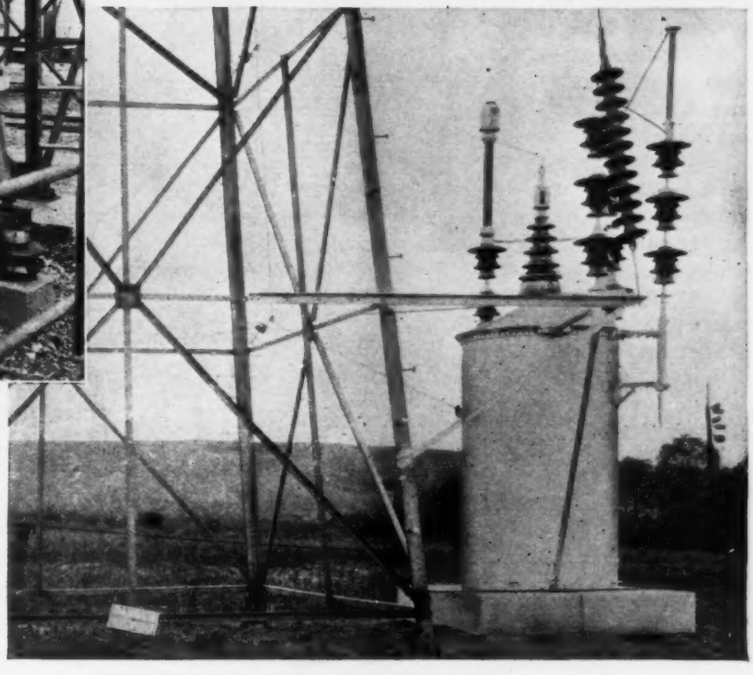


Tuned carrier-current trap

Cable type capacitor
at Canton







132-kv. tank type capacitors at Philo and Canton

$15,000 per Terminal for Carrier Communication

EXPERIENCE with carrier communication has been highly satisfactory, according to Philip Sporn, electrical engineer of the American Gas & Electric Company. It has reached the stage where it will, if properly applied, provide a quality and reliability of communication that is generally unobtainable at present through any other source at the same cost. Carrier-current equipment which is not able to render the service of the newly built sets can with a reasonable expenditure and effort be revamped to give substantially the same service as that being put out today.

The cost of installation varies not only with the type of sets employed but with the number and voltage of the coupling points and whether or not more than one channel per terminal is employed. Up to the present time line coupling has been employed exclusively on the 132-kv. lines of the American Gas & Electric system. It is possible to reduce the cost considerably by going to bus couplings. However, on the basis of the coupling practice now followed, the average cost per terminal has been running in the neighborhood of $15,000. This includes all overhead. The cost of the 30 terminals on the American Gas system represents an investment of approximately $450,000. These 30 couplings provide communication for a total of 1,340 linear miles of 132-kv. line. It is estimated that the cost of a single leased line providing approximately equivalent communication would cost in rentals approximately $75,500 per year.

Complete data on maintenance are not available over the system as a whole, but on one portion where cost records were kept maintenance cost, including all the necessary personnel for eighteen sets, in 1928 was approximately $9,000, or $500 per year per set. Using this unit figure the maintenance of the 132-kv. system represents a total of $15,000 per annum. Allowing 15 per cent for fixed charges the total cost of the carrier communication system is equal to $82,500 per year, the difference between the two forms thus being a total of $10,000.

Against this additional expense the following advantages must be balanced:

1. *Quality.*—The quality obtained over the carrier system has in general been equal to and in many cases better than what would pass for good commercial telephone quality. It is generally equal to the quality obtained in an all-cable commercial system and in the territory covered it is practically impossible to obtain an all-cable line of any reasonable length.

2. *Reliability.*—The reliability of the carrier communication system has undoubtedly been superior to that of any other form obtainable.

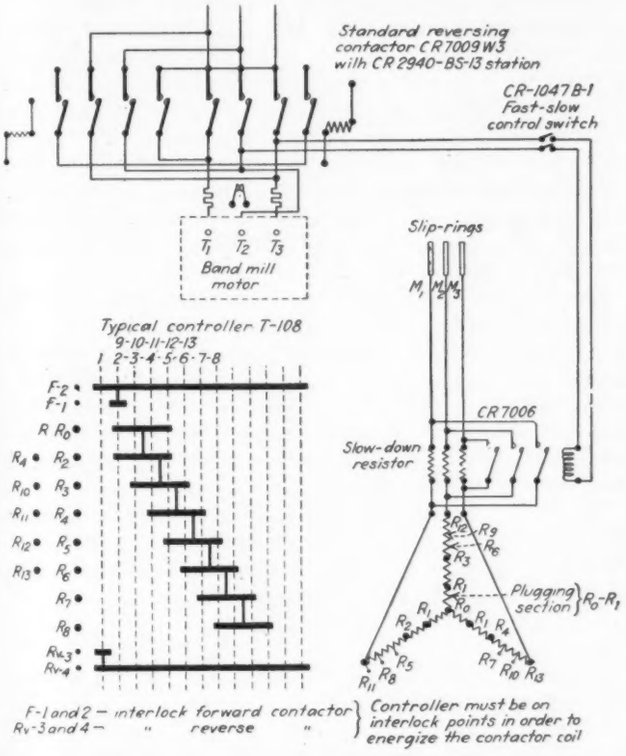
In regard to safety, there have been nine failures of coupling capacitors so far, all of which were on the first types of equipment employed, and in all these cases the protective system used between the power conductors and the equipment and operators has functioned correctly and no damage or injury of any kind has occurred to equipment or operators. With the placing of all lead-in conductors underground the present extremely small hazard will be further reduced. In all our carrier experience no case has ever occurred where injury to any person has resulted from failure of the equipment.

Sixty-four carrier sets on this 132-kv. system

Band-Saw Control Saves Production Time

By L. O. B. LINDSTROM
General Electric Company

IN SAWING logs a saw speed of 10,000 ft. per minute is ordinarily used, but when a frozen or hard log is encountered it is desirable to slow down to about 8,000 ft. in order to avoid making wavy lumber. Some mills take care of this by changing pulleys in the fall when frozen logs begin to come in, but the occurrence of hard


Standard reversing contactor CR7009W3 with CR2940-BS-13 station
CR-1047B-1 Fast-slow control switch
Slip-rings
Band mill motor
Typical controller T-108
9-10-11-12-13
1-2-3-4-5-6-7-8
CR7006
Slow-down resistor
Plugging section
F-1 and 2 — interlock forward contactor
Rv-3 and 4 — " reverse "
Controller must be on interlock points in order to energize the contactor coil

Plugging and slow-down control developed for high-speed band saw

logs at any time makes it advisable to have a convenient method of getting a slower speed.

The Susanville and Hilt plants of the Fruit Growers' Supply Company, California, were recently equipped with log band-saw plugging and slow-down control in addition to the hand-starting wound-rotor equipment.

The plugging control is used purely for time saving reasons, as the band saw regulates the output of the mill and even fractions of a minute lost result in a material loss in production. The band saw is usually changed about three to four times a day and about three minutes' time is consumed in the process. Four changes a day means twelve minutes lost, or, roughly, from 2,000 to 4,000 board-feet of production on a 200-hp. saw.

With the plugging control the saw can be brought to a dead stop in from 30 to 50 seconds without throwing the idler or the belt. Complete automatic control of this type has been used in several pine mills, but only a few have had their hand-starting control changed over to include the slow-down equipment.

The slow-down equipment consists of a 300- or 600-amp. magnetic switch, depending on the secondary current, connected so as to short out a block of resistor grids connected in series with the motor secondary leads before connecting to the controller. The regular starting resistor is not disturbed. The switch is energized by a magnetic switch marked "slow-fast," the fast position being that at which contact is made.

The plugging control consists of an inclosed reversing contactor, a 300-amp. rating being used from 150 to 250 hp. at 440 volts. With the latter rating silver contacts are used. The plugging resistor is cut in on the first controller points and the regular starting resistor is moved up and divided in fewer points. Interlocks provided on the hand controller necessitate going to the neutral position before the primary contactor can be closed in either the forward or plugging direction.

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What Is the Color of Daylight?

By M. LUCKIESH
Director Research Laboratory, National Lamp Works, Cleveland

VARIATIONS in the intensity of daylight with time, exposure and atmospheric conditions are too obvious to warrant discussion, but variations in the color of daylight are not so apparent. Daylight on the workplane often varies through the color range from direct sunlight to blue skylight during a period of an hour or two. Since the spectral composition of sunlight approximately obeys certain well-established laws governing the radiation from a so-called "black body," the most obvious method of describing the color of sunlight is to assign to it the temperature of a "black body" whose integral light is of the same color. Even the color of skylight and, therefore, the color of mixtures of it with direct sunlight can also be approximately expressed in color temperatures. In other words, at any specified color temperature the distribution of energy in the visible spectrum of any daylight is approximately the same as that from a "black body" at the same color temperature.

We present herewith a summary of some measurements which we made in September, October, March and April. The temperatures are expressed in degrees Kelvin (centigrade plus 273 deg.). All values excepting those for "direct sunlight" refer to light on a horizontal plane with unobstructed illumination from the whole sky. Color temperatures for the corresponding conditions are somewhat lower during the winter months and are probably higher during midsummer.

Type of Daylight	Approximate Color Temperature, Deg.
Direct sunlight, before 9 and after 3	4,400 to 5,000
Direct sunlight, 9 to 3	5,300
Sunlight plus light from a hazy or smoky sky	5,700
Sunlight plus light from a clear sky, 9 to 3	5,800
Light from a totally overcast sky	6,400
Light from a hazy or smoky sky	7,000 to 8,000
Light from a clear blue sky	10,000 to 20,000

The significance of these temperatures is indicated by the following table, showing the relative luminosities of

different portions of the spectrum, as compared with the composition of white light (approximately 5,300 deg. K.):

Spectral Regions	Relative Luminosities at Various Temperatures, Deg. K. 5,000	5,300	5,800	6,400	7,500	15,000
Wave Length in Angstrom Units						
4,000 to 4,900 (violet and blue)	94	100	107	115	128	166
4,900 to 5,500 (green)	98	100	102	105	108	116
5,500 to 5,900 (yellow)	101	100	99	98	97	92
5,900 to 7,200 (orange and red)	103	100	96	93	87	75

The data show that the quality or spectral character of daylight is extremely variable and emphasize the value of artificial daylight, which, while not accurately a reproduction of any particular quality of daylight, is at least constant in quality and quantity.

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READERS' FORUM

Wants More Data on Economy of Buried Cable

To the Editor of the ELECTRICAL WORLD:

V. A. McKillop, engineer of the Public Utility Commission, city of London, Canada, has suggested various points on which further enlightenment might be interesting in connection with an article by the writer on "Economy of Buried Cable" published in the October 19, 1929, issue of the ELECTRICAL WORLD. These points are:

1. The conduit installation costs appear too high and the armored cable costs too low, relatively.
2. The added length of using four routes would result in greater cost for armored cable, unequal sharing of load and waste of capacity.
3. Interest works in favor of armored cables at first, but later for conduit installation.

Local conditions will determine costs to a certain extent.

In this case the route used was an arterial highway 40 ft. wide occupied by street railway tracks, and traffic conditions were such that construction costs were undoubtedly higher than normal. However, the conclusions given in the article have not been made as the result of pure estimates, but are based on the actual costs of similar installations.

The cost of the conduit line is based on the actual cost of a similar conduit extension made on this same street a year ago where it was desirable to place a distribution feeder underground.

The costs of the 500,000-circ.mil paper-insulated cable are based on the actual cost of some of this cable in the conduit extension mentioned above, and the costs of the armored cable installation are taken from the construction ledger on this job except for the repaving item, on which no bill had been received. The repaving is done by the city of Omaha and the charges therefor are established by ordinance according to area and type of paving. Consequently this item is not greatly in error. The material for the splicing manholes in the armored cable installation was included in the miscellaneous item.

The conduit line we proposed to use consisted of nine 4-in. fiber ducts separated with 1½-in. (minimum) concrete, and with 3½-in. (minimum) concrete between the outside ducts and the earth. On account of underground obstructions at street intersections and the contour of the street manholes every block or 375 ft. would have been necessary. This would have required nine 6-ft. x 10-ft. manholes with the conduit line, whereas only four 4-ft. 6-in. x 7-ft. manholes were used with the armored cable installation.

The repaving would be greater with the conduit installation, requiring a trench 2 ft. wide, whereas an 18-in. trench was ample with the armored cable.

The writer agrees with Mr. McKillop that 15-kv. cable can be pulled in and jointed for approximately 20 cents per foot under the proper conditions. However, Chase type cable was used, which required a more expensive joint and more labor than would be required with belted cable. There are other costs which Mr. McKillop has apparently omitted, namely, fireproofing, engineering, use of tools, interest during construction, etc., which are proper capital charges. These have been included by the writer in all costs given.

Recent advances in cable practice have shown that Chase type cable is better designed than a belted cable and has greater current-carrying capacity under all conditions due to a higher permissible copper temperature, but where the ambient temperature conditions are favorable the difference between the two kinds of cable become still greater. In this case the shielded cable proved most economical in cost per kilovolt-ampere.

The added length which would be involved by using four different routes for the armored cable would alter the costs if all cables were to terminate at the same point. The editor deleted three words from the first sentence of the second paragraph of the article which should have read:

"A study of the ultimate requirements of the substation *and adjacent territory* indicated that a final installation of from six to eight cables would be needed," and created the impression that all cables were to end at that substation. However, this is not the case as the two existing cables will be ample for this substation, and the other four or six cables will be used to supply other substations or loads located beyond the substation in the same section of the city. Undoubtedly when these cables are installed to their various destinations, routes will be found that will actually be shorter instead of longer than would be necessary if the conduit line were used. Any saving made in this way, together with the ultimate saving of $10,000, could be applied on the extra cost of installing one cable at a time instead of two. We doubt if eight cables will be needed, but are reasonably sure six will be. If six cables should be the ultimate requirements, the saving effected by the armored cable installation will be still greater.

The writer has tried to be conservative in all estimates and give the conduit system the benefit of the doubt. Even if the cost of the conduit were cut in half, the result would still favor the armored cable installation.

Nebraska Power Company,
Omaha, Neb.

F. E. SMITH,
Chief Engineer.

Men of the Industry

R. E. Hellmund Receives Lamme Medal

RUDOLF E. HELLMUND, chief electrical engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been awarded the Lamme medal of the American Institute of Electrical Engineers for his contributions to the design and development of rotating electrical machinery.

A native of Germany, Mr. Hellmund had had some experience in designing electrical machinery in that country before coming to America. He was affiliated with the Krantz Company, Brooklyn, N. Y.; William Stanley of Great Barrington, Mass., and Western Electric Company at Hawthorne, Ill., before entering the employ of the Westinghouse Electric & Manufacturing Company in 1907 as a designer of induction motors. Later he was engaged in general engineering and consulting work. In 1926 he was appointed chief electrical engineer of the company.

In his engineering experience with the Westinghouse company Mr. Hellmund developed new ventilating systems and stator structures for various types of machines, numerous control systems, new armature windings, regenerative systems for railways, control systems and structures for phase converters and phase-converter locomotives, all of which are in practical use. He obtained in the neighborhood of three hundred United States and foreign patents covering various features of the above-mentioned and similar subjects.

Mr. Hellmund is the author of many papers which have appeared in the *Transactions* of the American Institute of Electrical Engineers and *Proceedings* of the British Institution and various other American and foreign technical magazines. He is a fellow of the American Institute of Electrical Engineers.

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H. HOBART PORTER, president of the American Water Works & Electric Company and chairman of the Engineering Foundation, sailed on the steamship *Columbus* on January 21 for a cruise around the world.

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I. REID CARLISLE has been appointed assistant to the president of the Virginia Electric & Power Company with headquarters in Richmond, Va., succeeding R. C. Hopkins, who was recently transferred to the Boston office of Stone & Webster. Mr. Reid removed to Virginia from Beaumont, Tex., where he was assistant to J. F. McLaughlin, formerly district manager in that territory, and recently promoted to be vice-president of the Stone & Webster organization, with offices in Boston.

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EDWARD H. HUBERT, formerly an assistant secretary of the American Institute of Electrical Engineers, has been appointed director of publicity for the National Electrical Manufacturers' Association to succeed Albert Pfaltz, resigned. At the American Institute of Electrical Engineers, where Mr. Hubert has been located during the last six years, he has been secretary of the meetings and papers committee and his work has been in conenction with the arrangement of convention programs and with publications. He was formerly with the McGraw-Hill Publishing Company, where he served in the editorial department of ELECTRICAL WORLD and other publications. Mr. Hubert was previously connected with the engineering department of the Georgia Power Company.

T. H. U. Aldridge Leaves China

T. H. U. ALDRIDGE, vice-president and general manager of the Shanghai Power Company, relinquished his duties on December 15, when he left for London, where he will be associated with the American & Foreign Power Company. C. S. Taylor, deputy manager of the Shanghai Power Company, has been selected to succeed him.

Mr. Aldridge became identified with the electrical industry in Shanghai in 1901 as head of the electrical department, as it was then called. At a later date the name of the department was changed to the municipal electricity department and Mr. Aldridge's title was changed from municipal electrical engineer to engineer-in-chief and manager. This position he occupied until the transfer of the S. M. E. D. to the Shanghai Power Company, when he became its first vice-president and general manager.

Mr. Taylor joined the Shanghai Municipal Electricity Department in 1913 as assistant power and substation engineer. The following year he was appointed substation and power engineer and in 1916 he was named consumers' engineer, in which capacity he was responsible for the negotiation of numerous contracts for the supply of power

to the textile and other industries. It was in 1923 that he was appointed deputy engineer-in-chief and manager, becoming deputy general manager when the municipal electricity department was transferred to the Shanghai Power Company. During Mr. Aldridge's prolonged absences when engaged upon the department's business in Great Britain and the United States Mr. Taylor has been responsible for the administration of the undertaking.

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P. H. Powers Directs West Penn Commercial Activities

P. H. POWERS, commercial manager of the West Penn Power Company, has been promoted to vice-president in

charge of all sales and commercial activities, including operation of division and district offices. Mr. Powers has been with West Penn since 1922.

Previous to this date he was with the Chester Valley Electric Company, Coatesville, Pa., from 1914 to 1919, with the exception of two years spent in army service. From 1919 to 1921 he was assistant division manager of the Kentucky & West Virginia Power Company at Williamson and Logan, W. Va., and from 1921 to 1922 with the American Gas & Electric Company.

Mr. Powers started with West Penn interests as division manager of the Keystone Power Corporation at Bellefonte, Pa., becoming general manager of that company in 1924 and commercial manager of West Penn at Pittsburgh in February, 1928, which office he held until his present appointment.

OBITUARY

CHARLES A. LUX, prominent in the electric power and electric railways of central and northern New York, died at his home in Syracuse, January 22, as a result of heart trouble. He was one of the original promoters of the Rochester, Syracuse & Eastern Railroad. Early in 1905 he began the building of the Rochester and Syracuse line, subsequently selling his franchises. In 1915 Mr. Lux severed his connections with railroad projects and with W. P. Gannon undertook the development of water power on the Salmon River in Oswego County. Several years later the holdings were sold to the Niagara, Lockport & Ontario Power Company. For the past two years he had been associated with Howell, Usher & Mitchell. He was also associated with oil and mining interests in the West and in Canada and had large realty interests in Cleveland and other cities.

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CLARENCE S. MACY, a leading figure in Iowa public utility circles, died January 7 after a week's illness that followed an operation for appendicitis. Adel, Iowa, was Mr. Macy's native city and the University of Iowa his alma mater. Twelve years ago he and his father organized the Adel Power Company and in 1926, when this property was purchased by the Iowa Power & Light Company, Mr. Macy became manager of the Adel office. In the course of his connection with the electrical utilities in Iowa he served as president of the Adel Power & Light Company, general manager of the Iowa Power & Light Company, a director of the Des Moines Electric Light Company and president of the Iowa section of the N.E.L.A. for four years.

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HENRY HOLGATE, prominent in Canadian engineering circles, died January 21 at his home in Montreal in his sixty-eighth year from an attack of angina pectoris. He was born at Milton, Ont., and educated in Toronto, and was for some years engaged in railway and bridge construction. He established himself in Montreal in 1894, where his activities were largely devoted to hydro-electric development. He spent some years in Jamaica, where he constructed and managed the hydro-electric tramway system at Kingston. On his return to Montreal in 1901 Mr. Holgate entered into partnership with Robert E. Ross and during the ten years of partnership they constructed many hydro-electric plants, including those of the West Kootenay Power Company and the Canadian Copper Company. In 1911 he became president of the Cedar Rapids Power Company and when he retired from that position was retained by the company as consulting engineer.

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Francis C. Pratt

FRANCIS COLE PRATT, formerly a vice-president of the General Electric Company, died January 26 at the Hotel Savoy-Plaza, New York, after a month's illness, at the age of 63. Mr. Pratt retired as an executive officer of the General Electric organization almost three years ago, following twenty years of service. Starting in 1906 as assistant to the vice-president in charge of engineering and manufacturing, he was appointed assistant to the president in 1912 and in 1919 he was named vice-

president in charge of engineering. At the close of 1924 he was appointed vice-president in charge of manufacturing to fill the vacancy caused by the resignation of George E. Emmons. With this appointment he also assumed the duties of chairman of the manufacturing committee of the General Electric Company. It was from these offices that he retired in June, 1927.

Aside from certain outside work on investigations and designs of special machinery, Mr. Pratt was employed from 1888 to 1906 by the Pratt & Whitney Company at Hartford, Conn., his father being president of the organization. He served as foreign sales manager, sales manager, secretary and vice-president. During the years 1891 to 1900 he spent a considerable portion of each year in Europe in connection with the company's foreign business.

Financial and Statistical News

CONVERTIBLE ISSUES are recovering their popularity of pre-market-break days. Several such issues in the utility field have begun to reflect active buying and prices have strengthened accordingly. This type of security has again become prominent also in new financing.

——CAPITAL SECURED PUBLICLY BY THE UTILITIES in January reached far beyond totals anticipated toward the end of the year. The total was $217,000,000.

——TRADING IN STOCKS CONTINUES LISTLESS, with utility issues on the average about where they have been since the first of the year.

Recognize Indiana as Insull Territory?

LITTLE BEYOND RECOGNITION of the territorial rights of the Insull interests in Indiana appears on the surface, at least in the stock deal entered into this week between said interests and the United Gas Improvement Company. The incident, however, suggests a logical development between several of the various groups in the direction of simplifying not only capital structures but geographic situations.

Midland United Company, which controls American Public Utilities, Midland Utilities, Interstate Public Service and Indiana Hydro-Electric Power, bought from United Gas Improvement Company 64,009 shares of Midland Utilities common and 28,336 shares of American Public Utilities common. This gives Midland United 100 per cent ownership of the former and 90 per cent of the latter. United Gas Improvement in return bought 448,170 shares of Midland United common, which is about 16 per cent ownership. Application is being made to list this on the Chicago Stock Exchange.

With the exception of an issue of 350,000 shares of common stock offered to the public in September, 1929, and the holdings being acquired by the United Gas Improvement Company, all of the common stock is owned or controlled by the Commonwealth Edison Company, Peoples Gas Light & Coke Company, Public Service Company of Northern Illinois and Middle West Utilities Company. Midland United Company owns or controls public utility companies serving 662 communities in Indiana, Ohio and Michigan.

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New York Edison Sales Up 9.8 Per Cent

SALES OF ELECTRIC ENERGY by the New York Edison Company and four associated companies in 1929 was 9.8 per cent greater than in 1928, sales for 1929 amounting to 3,674,193,914 kw.-hr., as compared with 3,314,314,898 kw.-hr. for the preceding year. The greatest increase in volume was in Manhattan, with 1929 sales exceeding 1928 by 141,919,587 kw.-hr., or more than 7.6 per cent.

The sales by sections for the year 1929 were as follows:

	Kw.-Hr.
Manhattan	2,005,134,075
Bronx	307,085,161
Brooklyn	953,194,284
Queens	358,465,743
Yonkers	50,314,651

CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

	1929	1928	Per Cent Increase	Operating Ratio 1929	Operating Ratio 1928
American Water Works & Electric (Year ended November 30)					
Gross earnings	$53,859,203	$50,822,123	5.9	50	52
Net earnings	26,837,074	24,716,558	8.6	..	..
Bangor Hydro-Electric (Year ended November 30)					
Gross earnings	2,064,964	1,974,393	4.6	45	46
Net earnings	1,137,089	1,068,784	6.4	..	..
Carolina Power & Light (Year ended November 30)					
Gross earnings	9,354,984	8,996,415	4.0	46	48
Net earnings	5,057,010	4,602,199	10.0	..	..
Cities Service (Year ended December 31)					
Gross earnings	44,786,447	34,744,597	28.8	..	..
Net earnings	43,452,387	33,584,465	29.5	.	.
Engineers Public Service & subs. (Year ended November 30)					
Gross earnings	50,494,852	31,173,932	62.0	58	59½
Net earnings	21,350,146	12,867,431	66.2	..	..
Federal Light & Traction & subs. (Year ended November 30)					
Gross earnings	8,477,145	7,843,650	8.1	60	68
Net earnings	3,450,249	3,168,757	8.9	..	..
Idaho Power (Year ended November 30)					
Gross earnings	3,826,302	3,494,045	10.0	48	47
Net earnings	1,986,184	1,846,152	8.0	..	..
Nebraska Power (Year ended November 30)					
Gross earnings	$5,950,389	$5,287,081	13.0	50	52
Net earnings	2,926,600	2,525,874	16.0	.	.
Pacific Power & Light (Year ended November 30)					
Gross earnings	4,747,719	4,511,244	5.0	52	54
Net earnings	2,281,978	2,083,167	10.0	..	..
Portland Electric Power (Year ended November 30)					
Gross earnings	12,728,990	12,509,115	1.8	60	60
Net earnings	5,082,923	5,029,053	1.1	..	..
Southern Canada Power (Year ended November 30)					
Gross earnings	2,122,962	1,875,592	13.2	36	33
Net earnings	1,368,159	1,260,752	8.5	..	..
Texas Power & Light (Year ended November 30)					
Gross earnings	9,831,406	9,711,589	1.0	50	53
Net earnings	4,853,745	4,590,944	6.0	..	..
Utah Power & Light (Year ended November 30)					
Gross earnings	11,721,750	10,992,167	7.0	50	49
Net earnings	5,794,058	5,664,256	2.0	..	..

NEWS BRIEFS

Canadian Hydro-Electric Corporation increased its output 61 per cent in 1929 to 2,088,896,000 kw.-hr.

Public Service Corporation of New Jersey reports $41,000,000 available for new construction in 1930.

Utilities in Oklahoma will spend $50,000,000 in new construction in 1930, Oklahoma Utilities Association reports.

Utilities Power & Light has purchased Maritime Coal, Railway & Power Company, Ltd., a Canadian concern.

Public Service Corporation of New Jersey placed its common stock on a $3.40 regular annual dividend basis against $2.60 regular and 80 cents extra.

Directors of Commonwealth Edison Company have announced to stockholders that a proposal to increase the authorized capital stock from $150,000,000 to $200,000,000 would be submitted at the annual meeting to be held February 24.

Rockland Light & Power Company has filed in Albany a certificate of increase in capital from $12,200,000 to $26,000,000 and will offer its stockholders rights to purchase at par, or $10 a share, one additional share for each share held.

New York Stock Exchange has authorized the listing of 60,246 additional shares of common stock of the Pacific Gas & Electric Company.

Gold debentures of Insull Utility Investments, Inc., to the amount of $60,000,000 have been listed on the Chicago Stock Exchange.

The thirteenth annual report of the Montreal Light, Heat & Power Consolidated, just issued, shows gross revenue totaling $22,286,214, as compared with $21,235,991 for the preceding year and, with the ratio of expenses to revenue well maintained, net revenue amounting to $11,541,047, as against $10,794,979 in 1928.

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Canada Makes Heavy Capital Expenditures

CAPITAL EXPENDITURES INVOLVED in the development, transmission and distribution of new power in Canada represents a very considerable proportion of the total expenditure in building construction there. The 1929 outlay involved probably more than $75,000,000, while not less than $320,000,000 will likely be required to complete the undertakings planned for the next three years.

The steady growth of water-power development throughout the Dominion during the past few years was substantially maintained during 1929, with practically every province represented in the program of activities. This is disclosed in a review prepared by the Dominion Water Power and Reclamation Service of the Department of the Interior.

The total capacity of new installations brought into operation during 1929 amounted to 378,400 hp., bringing the total installation for the whole Dominion to a figure of 5,727,600 hp. There are, as well, a number of important undertakings under active construction which, according to the program proposed, will add more than 1,600,000 hp. to this total during the next three years. In many of these undertakings an initial installation only is involved, and when they are ultimately completed to their full-designed capacities a further 1,500,000 hp. will be added to Canada's total. In addition, a number of important projects are under active study, some of which will undoubtedly materialize during the next few years. It is apparent, therefore, that the rate of growth of recent years will not only be maintained but will be considerably increased.

Quebec leads in the magnitude of undertakings under way and in those completed in 1929, as has been the case during the past few years, while important developments have recently been brought into operation or are well advanced in Ontario, British Columbia, Alberta, Saskatchewan, Manitoba, New Brunswick and Nova Scotia.

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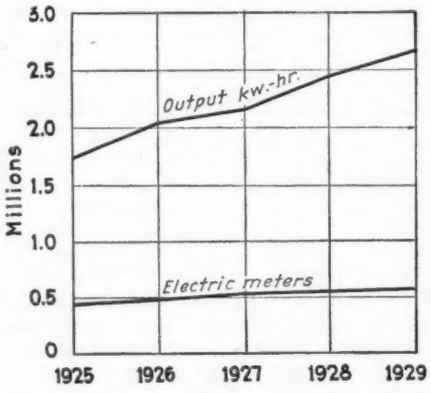
Detroit Edison Felt Drop in Industrial Power

SEASONAL industrial decline and stock market break are reflected in Detroit Edison's earnings. Industrial power sales had less than their normal increase. Slackening occurred in the motor car and some other industries in September and some manufacturers leaned backward after the market crash. But since December industrial demand has grown steadily. In most other regards the year was a good one. Some of the high spots were:

Gross earnings up 8 per cent
Net earnings up 4 per cent
Operating ratio 53.4 against 52.6 in 1928
Power output up 8.9 per cent
Maximum load up 7.9 per cent
Average use of current per household 641 kw.-hr. against 581 kw.-hr.
Depreciation allowance 13 per cent of gross and 3 per cent of plant investment.
Profit and loss surplus up 30 per cent
Assets up 14 per cent to $296,122,072.



Electrical output shows steady increase

Detroit Edison common earned $11.17 per share last year against $12.24 in 1928. The price range last year was $385 and $151. Current price of around $209 is approximately 19 times last year's earnings.

The output from the several power plants was in 1928 2,438,304,900 kw.-hr. and in 1929 2,654,901,300, an increase of 8.9 per cent. The number of electric meters in service on December 31, 1929, was 570,832, an increase of 20,760.

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$103,000,000 in Securities Authorized in California

DURING 1929 the California Railroad Commission authorized the issuance of $103,288,473 of stocks, bonds and notes by several classes of utilities, including steam railroads, electric railways, gas and electric companies, water companies,

telephone and telegraph companies warehouses, carriers by water and automotive carriers, as against $148,929,337 authorized in 1928.

Of these totals, the amounts of securities authorized to be issued to finance construction costs decreased during 1929 from $103,416,277 to $71,718,736, according to a statement released by the California Railroad Commission. The statement continues: "It appears that this decrease was due in part to the fact that during 1928 a considerable volume of stock was authorized to be issued by telephone companies for purposes which were not of an annual nature and by the fact that few gas and electric companies found it necessary or desirable to expend large sums for production facilities. It appears, however, that electric and gas companies continued the expenditure of large sums of money for transmission and distribution facilities. The reports of the commission show that for new properties, the California-Oregon Power Company was authorized to issue $1,500,000 of common stock; Pacific Gas & Electric Company, $22,752,000 of stock; Southern California Edison Company, $16,400,000 of stock and $17,000,000 of bonds; San Diego Consolidated Gas & Electric Company, $3,000,000 of stock; Santa Maria Gas Company, $1,199,300 of stock; and Southern Counties Gas Company of California, $2,000,000 of stock. In addition, there was pending at the close of the year an application of Southern California Edison Company to issue an additional $7,075,000 of its common stock to carry on its construction work during 1930.

The amount authorized for reorganization purposes closely approximated the amount granted in the preceding year.

Portugal, 16 per Cent Electrical Growth

PORTUGAL HAS 354 electric power plants with a combined capacity of 135,722 kw. The aggregate output of energy amounted in 1928 to 216,865,558 kw.-hr., as against 186,995,246 kw.-hr. in the preceding year. The hydro-electric plants were responsible for 68,041,501 kw.-hr. of the total—an advance of 24.31 per cent—and the steam and internal-combustion engine stations for 148,824,057 kw.-hr., a progress of 12.52 per cent, the gross output showing an increase of 15.97 per cent over 1927.

These figures are taken from a 140-page report on the progress of electricity supply during 1928, lately issued by the electrical division of the General Administration of the State Hydraulic Service of Portugal. The report consists mainly of exhaustive statistics giving numerous details regarding the individual plants, their equipment and output and significant ratios regarding the country's use of electricity. It contains also a list of all the concerns, municipal and private, supplying electric power throughout Portugal.

The 69 hydro-electric plants in the republic have an installed capacity of 33,634 kw.; 42 of them (28,110 kw.) are owned by local authorities or companies and 27 (5,524 kw.) are private plants. Of stations operated by steam and internal combustion engines there are 285 with a total of 102,088 kw. Of these 116 (67,189 kw.) are municipal and public-company owned and 169 (34,899 kw.) private. The 102,088 kw. total is made up of 82,418 kw. driven by steam, 13,187 kw. by oil, and 6,483 kw. by producer gas.

At the beginning of 1929 there were in the country 1,070,968 miles of transmission lines ranging from 2,000 to 75,000 volts, 876,003 miles being overhead and 194,965 miles underground, according to the report.

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New Utility Issues Total $217,000,000

JANUARY ushered in the new year with a total of $217,000,000, this figure representing new offerings of debentures, bonds and notes of the electric light and power companies of the country. It is interesting to note that no new stock issues appear in the tabulation. This total compares with $82,916,000 in December and $79,865,000 in January, 1929. In fact, it is the largest sum recorded for any month since April, 1928, when new utility offerings amounted to $279,535,000.

Attention is called to the number of issues that was entirely or partially offered for refunding purposes. Though long-term financing predominated, two short-term offerings of notes were made. The average yield reached the 5.64 per cent mark as compared with 5.46 per cent in December and 5.28 per cent in January, 1929.

NEW SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN JANUARY

Name of Company	Amount of Issue Par Value	Period Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Insull Utility Investments, Inc.	$60,000,000	10	Gold debentures, series B.	To raise funds to pay off current indebtedness and to provide company with a substantial cash sum	6	99½	6.07
Sioux City Gas & Electric Co.	1,000,000	30	First mortgage gold bonds.	To reimburse treasury for funds expended for additional property, to provide for further additions and extensions to the properties and for other corporate purposes	5	93	5.45
North American Edison Co.	25,000,000	39	Debentures, series C.	To provide funds for additional investments in the company's subsidiaries and for other corporate purposes	5	95½	5.25
Associated Gas & Electric Co.	30,000,000	20	Convertible gold debentures	To retire securities, to acquire additional properties and for other corporate purposes	5	90	5.85
Edison Electric Illuminating Co. of Boston	30,000,000	3	Coupon gold notes	To retire all floating indebtedness and for future extensions of the property	5	98½	5.45
New England Power Association	25,000,000	25	Gold debentures	To retire short-term loans, construction, addition and extensions and for other company purposes	5½	95	5.88
Public Service Electric & Gas Co.	20,000,000	40	First and refunding mortgage gold bonds	To reimburse company for expenditures made and to be made for additions and improvements to properties	4½	95½	4.75
Iowa Public Service Co.	1,000,000	29	First mortgage gold bonds.	To reimburse for expenditures on additions made and to be made and for other corporate purposes	5½	98½	5.60
Central Gas & Electric Co.	10,000,000	3	Gold notes	To retire notes	5½	98½	6.15
Washington Water Power Co.	15,000,000	30	First and general mortgage gold bonds	Acquistion of properties	5	98½	5.09
Total	$217,000,000			Rights	7,281,200		
Total amount actually realized	$209,635,000			Total financing for January	$216,916,200		

Business News and Market Conditions

N. E. M. A. Makes Plans for Floodlighting Section

FURTHER STEPS were taken in organizing a floodlighting and airport lighting section of the National Electrical Manufacturers' Association at a conference held January 21 at the Westinghouse Lighting Institute in New York. Representatives of nine manufacturers were present and officers were elected as follows: Chairman, J. C. Herron of the Reflector & Illuminating Company, and secretary, W. H. Robinson, Jr., of the General Electric Company. This meeting carried further the proposals made in Detroit December 19, when organization of the proposed section was started.

Plans were made for the future work of the section, including the preparation of standards and the collection of statistics. It was decided to appoint two standardization committees, one for airport lighting and the other for all other types of floodlighting. Standardization of wattage ratings and standard specifications for illumination will be referred to both committees. The airport lighting committee will be requested to review the Department of Commerce specifications on this subject.

It was decided that statistics should be collected on billings of sales in both dollars and units, exclusive of equipment supplied to the United States government and for export.

Representatives of the following manufacturers were present at the meeting: B.B.T. Corporation of America, Crouse Hinds Company, Curtis Lighting Company, Electric Service Supplies Company, General Electric Company, Pyle-National Company, Reflector & Illuminating Company, Sperry Gyroscope Company and Westinghouse Electric & Manufacturing Company.

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Plan Advertising School at Westinghouse Institute

THE Metropolitan New York Section of the N.E.L.A. announces that a school for electrical advertising will be held on February 26, 27 and 28 at the Westinghouse Lighting Institute, Grand Central Palace, New York City. This school will be similar to five other schools which have been held during the past two years at Chicago, Cleveland, Cincinnati, Harrison and Boston. Leaders in the electric sign and outdoor advertising industries will take part and those attending will study means for developing the central-station sign load, the value of electrical advertising as a load builder and the proper design of signs and accessories. There will be no tuition fee.

Worthington Pump Establishes California Company

THE INTERESTS OF THE Worthington Pump & Machinery Corporation in the California territory will be served through the formation of a local company, the Worthington Machinery Corporation of California, Ltd., with head-

Equipment Trade Will Be Normal

By CLARENCE L. COLLENS

President National Electrical Manufacturers' Association

THE electrical manufacturing industry during 1929 enjoyed a prosperous year. In many of its branches business was above what might be considered normal growth and development. Recession was under way and could have been expected, entirely aside from whatever effect the sudden and unprecedentedly rapid deflation of the stock market may have had. Personally, I feel that the latter will have little effect during the year 1930 on our business as a whole, and that the year 1930 will be a return to normal in those lines which have been above normal during 1929.

* * *

There is no indication that projects involving electrical apparatus and supplies will be held up.

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In the industrial fields improvements and betterments and the modernization of plant methods and equipment may not result in business for the electrical industry which will reach the peaks of 1929, but it should be about half way between the levels of 1928 and 1929.

* * *

There has been speculation in stocks, but no speculation in business. Inventories are normal and no losses will have to be taken because of the deflation of inventory values. Hand-to-mouth buying has justified itself.

* * *

Never before was there a greater need of price policies which are simple, definite, easy of administration and easily understood by the purchasing public and by one's competitors. Secret rebates or secrecy regarding any of the elements which determine final cost to the buyer do not promote healthy, stabilized economic competition. Price schedules, the classification of customers, terms and conditions of sale and of all other factors which go to make up the price structure should be printed and distributed generally, not only to the public, but to one's competitors.

* * *

N.E.M.A. can fit into part of this picture. It cannot, and does not, determine price levels. The law of supply and demand and intelligent or unintelligent competition determine where price levels will be, but N.E.M.A. can be a forum for discussing business policies. It can supply facts which will assist in the intelligent conduct of each individual business. It can promote codes and rules governing competitive practices and tending to eliminate unfair and unethical competition. I am convinced that it can indorse and advocate the principle of firm bidding.

quarters at Los Angeles and San Francisco.

H. D. Cornell, who has been president of the Worthington Machinery Corporation of Oklahoma, will be president of and direct the new corporation, moving to California for that purpose. George W. Hawkins, who has been director of sales, will also go with Worthington-California, as vice-president. The Worthington Machinery Corporation of California, Ltd., will take over the sales and engineering staff and the warehouse facilities of the Worthington Company, Inc., in California, and will hereafter handle all that territory. This arrangement will enable the carrying of larger and more diversified stock.

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Cooper Hewitt Assumes New Name

THE COOPER HEWITT Electric Company will be known as the General Electric Vapor Lamp Company on and after January 1, according to an announcement by William A. D. Evans, president. The trade mark Cooper Hewitt heretofore used will be retained as the trade designation of the products manufactured by the General Electric Vapor Lamp Company. "For the past ten years the Cooper Hewitt company has been a subsidiary of the General Electric Company," Mr. Evans said, "and this change in name will coordinate its activities more closely with the General Electric Company itself and will also permit the wider use of the General Electric monogram. It is expected that from time to time the products of the company will be added to.

There will be no change in the general policy or personnel of the organization." The Cooper Hewitt Electric Company specializes in the manufacture and sale of Cooper Hewitt lamps for industrial purposes, and for photographic studios, as well as quartz ultra-violet lamps, mercury switches, low-voltage neon tube lamps and neon glow lamps.

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Copper Market Dull—Prices Unchanged

	Jan. 22, 1930 Cents per Pound	Jan. 29, 1930 Cents per Pound
Copper, electrolytic	18	18
Lead, Am. S. & R. price	6.25	6.25
Antimony	8¾	8¾
Nickel, ingot	35	35
Zinc, spots	5.50	5.60
Tin, straits	38¼	39¾
Aluminum, 99 per cent	24.30	24.30

Westinghouse Electric Receives New Orders

IT HAS BEEN ANNOUNCED that the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., recently placed with the Westinghouse Electric & Manufacturing Company an order for a 30,000-kva., 60-cycle to 25-cycle, frequency converter.

Buffalo General Electric Company of Buffalo has placed with the Westinghouse Electric & Manufacturing Company an order for the complete equipment for twelve substations to supply the city of Buffalo's new 60-cycle distribution system. The equipment includes 36 2,500-kva., three-phase transformers, 108 automatic induction feeder regulators rated at 83.5 kva. and complete automatic reclosing switching equipment.

The Los Angeles office of the Westinghouse Electric & Manufacturing Company announces the sale of a 15,000-kva., 11,500-volt, 750-r.p.m. hydrogen-cooled synchronous condenser to the Southern California Edison Company intended for use in its San Antonio substation.

Swann Centralizes Subsidiary Activities

SWANN RESEARCH, INC., has been organized with a capital of $250,000 and laboratories at Anniston, Ala., to co-ordinate and unify the research and development activities of the various subsidiaries of the Swann Corporation. Some of the outstanding developments of the research departments of the Swann subsidiaries have been: The development of an electric furnace method of producing phosphoric acid, and also ferro-phosphorus as a by-product; improvement in quality of aluminous abrasives and silicon carbide; spray-congealed trisodium phosphate; spray-dried calcium and sodium salts of phosphoric acid; diphenyl and diphenyl derivatives.

The following officers will serve as a board of directors: Theodore Swann, president; B. G. Klugh, vice-president in charge of commercial research; J. N. Carothers, vice-president in charge of research; W. R. Seyfried, vice-president in charge development; Paul Logue, vice-president in charge St. Louis research and development; C. M. Jesperson, treasurer; F. A. Lidbury, director.

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Market Conditions

VOLUME OF EQUIPMENT orders in the East have been very satisfactory during the past two weeks but are showing a tendency to ease at the moment. Substation and line equipment are features. Railway electrification is active.

——SMALL EQUIPMENT SALES, especially to industrial concerns, are substantial in the New England district.

PACIFIC COAST

—THE WEEK WAS FEATURED *by bids covering major items of pole line construction aggregating $250,000 poles and three carloads of copper wire for two central California companies, also a $20,000 crossarm contract.*

Other interesting orders covered $10,000 worth of fixtures for the new Shell building in San Francisco, $5,000 worth of fixtures and prospective lamp contracts aggregating $40,000 for paper companies, a 150-hp. synchronous motor and controls, value $3,500, for a paper house; a mechanical drive turbine for an oil company, $25,000 worth of motor and control cubicles for a Port Angeles pulp plant, $20,000 worth of rotors, shields and stators for a pumping plant manufacturer, a $15,000 Westinghouse spindle cylinder for a San Francisco steamship line and a $40,000 turbo-generator for Honolulu. Paper and oil company purchases feature industrial business. The outstanding machinery order covers four General Electric 6,667-kva. transformers to be used in pumping service for East Bay service. Factory financial conditions have produced a cautious market, according to local radio dealers, but an encouraging feature is that their own stocks average only about one month. Distributing transformer sales are excellent and for the first year in the coast history have continued uniformly good throughout the year. Prospective building includes such major items as $11,000,000 for aviation buildings and a $2,650,000 terminal for Los Angeles. A $5,000,000 potash plant for Bakersfield, a $2,000,-

000 expenditure at Mare Island navy yard, a distributing system for a naval ammunition dump at Hawthorne, Nev., and a $1,250,000 post office for Sacramento.

Definite assurance of immediate construction of a $2,000,000 steam-generating plant in Tacoma by the city was given when the official call for bids for one 25,000-kw. steam turbo-generator set, generator air cooler, motor-generator exciter set, voltage regulators and condensers was issued, figures to be opened on February 3 and 5. The initial apparatus purchase will exceed $400,000. Plans for the plant, now being prepared, will be ready for figures within six weeks. The Seattle City Council passed a resolution authorizing a $10,000,000 bond issue providing for extensions to the municipal lighting and power system, heretofore mentioned. Also accepted was the plan of L. A. Decou and associates to construct a 26-story city light building, a portion of which will be devoted to substation purposes. British Columbia Electric Railway Company is taking bids until February 10 for eight suspension and eight anchor towers to carry a high-tension transmission line from the Ruskin hydro-electric development to Burnaby, the completed line to cost $750,000. The city of Seattle will call bids shortly for about $45,000 worth of voltage regulators and $2,000 worth of switchboard equipment and is now taking bids for seven pumps, four equipped with 35-hp. motors and three with 20-hp. machines. The Puget Sound Pulp & Timber Company, Everett, has opened bids for about $25,000 worth of pumps for which motors have been purchased. The inclement weather of the past month reduced motor sales to mills and allied industrials to a minimum. Last week's sales reported included ten machines from 25 hp. down to a cannery machinery manufacturing plant, 25 from 20 hp. down to miscellaneous sources and about 20 from 50 hp. down to lumber manufacturing plants.

CONSTRUCTION PROJECTS

Southern California Edison Company, Los Angeles, Calif., plans extensions in transmission lines in Tulare County to cost $450,000, including construction of power substations at Bliss and Octol; also, will build power substation at Pixley, Calif., and extend transmission lines there, estimated to cost $185,000. San Joaquin Light & Power Corporation, Fresno, Calif., plans steam-operated electric power plant at Buttonwillow to cost about $3,000,000; and will build a hydro-electric power plant at Merced Falls, Calif., to cost about $250,000. Cudahy Packing Company, Chicago, Ill., plans extensions in plant at Los Angeles, Calif., to cost more than $150,000. American Creamery Company, Oakland, Calif., plans plant to cost $225,000. Pacific Power & Light Company, Portland, Ore., plans power plant at Bend, Ore., to cost $140,000, and extensions in transmission lines in that section to cost $100,000.

SOUTHWEST

—CENTRAL-STATION BUYING *continues to be good in this district and the street railway companies are buying equipment in good volume. A slight falling off has been noted in sales of industrial supplies and machinery.*

One manufacturer interviewed says there is a good business in motors, especially fractional horsepower. No change in movement of building materials since last report. No large contracts for equipment or construction material have been closed, but several are reported in the making.

CONSTRUCTION PROJECTS

Campbell, Mo., is having plans drawn for a municipal electric light and power plant to cost $75,000. International Harvester Company, Chicago, Ill., plans addition to factory branch and distributing plant at Springfield, Mo., to cost $80,000. Springfield, Mo., plans extensions in street-lighting system. Arkansas Utilities Company, Helena, Ark., plans installation of street-lighting system at Marianna, Ark. Arkansas Power & Light Company, Pine Bluff, Ark., plans ice-manufacturing plant at Forrest City, Ark., to cost about $60,000. Southwestern Public Service Company, Amarillo, Tex., plans installation of an ornamental lighting system. Kimbell Milling Company, Fort Worth, Tex., has filed plans for a grain elevator to cost $250,000.

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NEW ENGLAND

—ELECTRICAL INDUSTRIAL EQUIPMENT *demands are stronger. Inquiries for central-station supplies are gaining; sales are in small lots. Heavy equipment for power generation is attracting attention and inquiries are being received in good volume.*

—INDUSTRIAL EQUIPMENT *sales, small motors, small switches and control equipment are encouraging; prominent manufacturers and a representative of a nationally known distributor report that this month's volume in orders for this equipment will exceed that recorded for last year.*

Small motor sales total for the past week was above $20,000 in this district, according to one manufacturer; fractional motor sales are increasing due to growing demand by machine and tool manufacturers who are interested. Central-station sales are spotty, but encouragement is felt in view of increasing inquiries; substation additions, together with line extensions, presage a good sales volume; in southern Massachusetts plant extensions are being considered by a municipal plant costing about $140,000. In western Massachusetts similar extensions to service are announced. Industrial activity is awakening in this district, according to a recent survey; in Worcester a well-known car manufacturing company recently received an order for 33 multi-unit control trail cars for use on the electrified divisions of the New Haven Railroad amounting to $1,000,000.

A prominent ice company in Boston plans to extend its ice-manufacturing facilities and is projecting another plant. Merchandising is steady and is gaining as compared with last year.

CONSTRUCTION PROJECTS

New England Power Company, Worcester, Mass., plans extensions in transmission lines from Lowell to Chelmsford, Mass. Rising Paper Company, Housatonic, Mass., has authorized an addition to mill to cost $100,000.

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SOUTHEAST

—ACTIVITIES IN THE *Southeast were looking up last week, with an increase in both size and number of central station and industrial orders.*

A large company ordered $125,000 worth of 110-kv. circuit breaker equipment for use on its properties in North Carolina, Tennessee and Louisiana, while a South Carolina company ordered circuit breaker equipment costing $15,000. An east Tennessee company placed orders for outdoor metering and switch house equipment amounting to $27,500. Some other central-station orders were for $7,800 of distribution and small power transformers, $5,150 of line materials and $4,610 of creosoted pine poles. A municipal plant under construction in South Georgia ordered transformers, switching equipment, switchboards and lightning arresters aggregating $36,000. A woodworking plant in Florida ordered a turbine costing $50,000 and a cotton mill in South Carolina ordered power transformers to the extent of $22,000. A manganese mine in Georgia ordered $10,000 worth of motor equipment and a cotton mill in the same state let an electrification contract which will involve the purchase of $35,000 worth of electrical apparatus and materials for the mill and three 833-kva. transformers for the power company to supply this mill.

CONSTRUCTION PROJECTS

Quartermaster Corps, United States Army, Langley Field, Va., will receive bids until February 10 for electric-operated vertical centrifugal pumps (Circular 35). Chesapeake & Ohio Railroad Company, Richmond, Va., will equip coal piers at Newport News and Hampton Roads, Va., with electric operating and handling equipment, each to cost in excess of $1,000,000. Quartermaster, United States Army, Camp Knox, Ky., will receive bids until February 10, for creosoted poles, crossarms, wire racks and other electrical supplies (Circular 31). Tennessee Light & Power

Company, Springfield, Tenn., plans extensions in transmission lines in the vicinity of Camden, Tenn., with power substation facilities. Knoxville, Tenn., plans ornamental lighting system. Knoxville Power & Light Company, Knoxville, Tenn., plans transmission line to Louisville, Tenn., and vicinity with substation facilities. Virginia Electric & Power Company, Richmond, Va., plans extensions in transmission lines at Williamston, N. C., and vicinity. Duke Power Company, Charlotte, N. C., plans transmission line from generating station on Saluda River to Newberry, S. C., and vicinity. South Carolina Power Company, Charleston, S. C., plans extensions and improvements in power substation. Mississippi Power Company, Gulfport, Miss., plans extensions and improvements in steam-operated electric power plant, including installation of additional equipment.

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EASTERN

—THE HEAVY VOLUME *of commitments by central stations during the past fortnight has tended to ease the situation in the electrical equipment market in the New York district. Orders show a tendency to smaller volume and amounts from that quarter. Inquiries, however, are holding up well and there is sizable business in sight.*

—INDUSTRIAL DEMAND *is still of rather negligible character and is expected to continue at that status for at least a month. Electric railway account is developing an encouraging level.*

The demand from power companies tends to substation and line equipment. A central station in northern New York has ordered a quantity of control apparatus from a state manufacturer to an amount of $60,000. A metropolitan utility has purchased a quantity of network protectors from the same maker, to cost about $175,000. A New York manufacturer has secured a contract for a generator, exciter and auxiliary equipment for an installation in Oklahoma, the order for condensers, etc., going to a Wisconsin producer, and for transformers, to a Missouri manufacturer. A maker of switching equipment states that business is good both for outdoor and indoor apparatus; orders are not of individual strength, however, but a volume of smaller commitments which is rounding out a sizable total.

Railway electrification is assisting the temporary lull in demand from other quarters. John A. Roebling's Sons Company, Trenton, N. J., has been securing a heavy allotment of orders from the Pennsylvania Railroad for cable, wire, etc., aggregating more than $1,000,000, and further business is anticipated. New York Central Railroad has placed a contract for three oil-electric locomotives with the General Electric Company and American Locomotive Company. A street railway in New York has purchased truck mechanisms from a state manufacturer, to cost about $40,000. A steam railroad in New York has contracted for a quantity of insulating materials from the same maker, totaling $25,000. Delaware, Lackawanna & Western Railroad has approved plans for power substations at Bergen Junction and Bernardsville, N. J., in connection with the electrification of its suburban lines, now in progress. Pennsylvania Railroad is said to be planning early awards for work for its electrification program on the main line between New Brunswick and Trenton, N. J.

A manufacturer of insulators for high-tension service and other line materials reports an active call from power companies and railways. Present orders are higher than in January, 1929, and indicate record proportions in the near future. A maker of electric washing machines is running on a capacity schedule at plant in the Middle West and shipments are running as high as 800 to 1,000 units per day. A producer of electric storage batteries in Pennsylvania says that incoming business is equaling that of a year ago this time, with every indication for continuance. Electric refrigerator account continues active and plants of three leading makers are running at capacity.

CONSTRUCTION PROJECTS

Western Electric Company, New York, has approved plans for three additions to cable and telephone equipment plant at Kearny, N. J., to cost in excess of $3,500,000. Donner-Hanna Coke Company, Cleveland, Ohio, plans extensions in steel plant at Buffalo, N. Y., to cost $2,000,000. Anchor Cap & Closure Company, Long Island City, N. Y., will build an addition to metal cap plant, reported to cost over $175,000. The General Electric Company, Buffalo, N. Y., contemplates an addition to branch plant at Oakland, Calif., to cost over $500,000. Colonial Dye Works, Inc., Long Island City, N. Y., plans plant to cost over $300,000. Radio Corporation of America, Inc., New York, has plans under way for a transmitting station at Bound Brook, N. J., to cost over $500,000. New York Central Railroad Company, New York, has filed plans for a power plant to cost $50,000. Pittsburgh Steel Company, Pittsburgh, Pa., is considering plant at Gibsonton, Pa., to cost more than $2,000,000. Dravo Contracting Company, Neville Island, Pittsburgh, Pa., will carry out an expansion and improvement program at shipyard to cost over $200,000. Eastern Rolling Mill Company, Baltimore, Md., will carry out an expansion and improvement program to cost $300,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until February 11, for a quantity of magnet wire for eastern and western yards (Schedule 2673). General Purchasing Officer, Panama Canal, Washington, D. C., will receive bids until February 13 for an electric lighting plant, ammeters, panelboards, transformers, electric wire and other electrical supplies (Panama Schedule No. 2527). Bureau of Yards and Docks, Navy Department, Washington, D. C., is asking bids until February 12 for refrigerating machinery for the Charleston, S. C., navy yard (Specification 6029.)

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MIDDLE WEST

—BUSINESS IN THE *Middle West section continues on a generally satisfactory basis. Some little inactivity is noticeable in certain lines of industry, but the general volume of business is substantial, although carloadings are slightly below last year's figures for a corresponding period.*

—RAILROADS ARE CONTINUING *their purchasing of equipment and the steel industry is operating at a slightly higher level. The electrical industry continues with plans outlined last year, with quite a large amount of construction work scheduled; several large projects are contemplated for the Chicago district.*

There has been a good demand for apparatus with a steady demand for distribution equipment. One interesting order placed this week was for an addition to a present substation to cost $80,000.

Jobbers' sales are somewhat slow. Industrial activity has been spotty, although railroad business has been particularly good. Most appliances have had a ready sale with no outstanding exceptions. Prices remain generally steady.

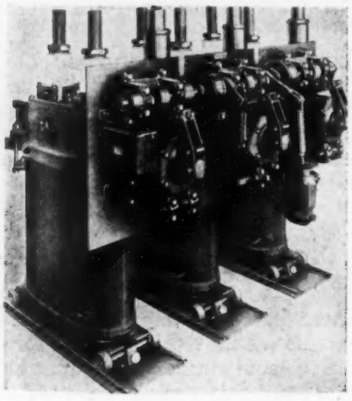
CONSTRUCTION PROJECTS

Consumers Power Company, Jackson, Mich., plans addition to power substation at Grand Rapids, Mich., to cost more than $80,000. Wabash Railroad Company, St. Louis, Mo., will soon take bids for an engine house and shops at Decatur, Ill., reported to cost $100,000. Alton Baking & Catering Company, Alton, Ill., will build a baking plant to cost close to $90,000. Granite City Steel Company, Granite City, Ill., will build an addition to plant to cost about $80,000. Marlatt Battery Manufacturing Company, Danville, Ill., plans an addition to cost more than $50,000. Commonwealth Edison Company, Chicago, Ill., will build a three-story substation to cost $400,000. University of Indiana, Bloomington, Ind., will take bids for a chemistry building to cost about $350,000. State Line Generating Company, Hammond, Ind., will double capacity of steam-operated electric power plant to cost $27,500,000. Dayton Electrotype Company, Dayton, Ohio, plans plant addition to cost $120,000. Tyson Roller Bearing Company, Massillon, Ohio, plans plant to cost about $75,000. Northfield, Minn., is having plans prepared for a municipal electric light and power plant. Minneapolis, Minn., plans installation of floodlighting system and beacon lamps at proposed municipal airport to cost $200,000.

New Equipment Available

Quick-Clearing, High-Speed Interruption

AN OIL CIRCUIT BREAKER known as type F-110, of relatively high interrupting capacity and comparatively small overall dimensions, has been placed on the



market by the Condit Electrical Manufacturing Corporation, Boston, Mass.

Quick-clearing, high-speed interruption, it is claimed, is secured by an arcing contact structure which combines the desirable advantages of magnetized arc zones, thermal absorption capacity and occluded contacts, along with a low inertia, instantaneous type mechanism and electromagnetic accelerators.

This breaker is of the indoor type, designed for cell structure, truck or platen mounting, furnished for 2,000 amp. or less at 15,000 volts, with an estimated interrupting capacity of 10,000 amp. at 15,000 volts.

The frame or pole top is of massive, rugged construction, to afford the rigidity necessary to assure proper functioning of the mechanism and strength to resist unbalanced stress and strain.

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A NEW BRACKET FOR STREET LIGHTING INSTALLATIONS with malleable iron pole plates in place of the usual cast-iron ones, and also two lag pole plates which allow an adjustment to compensate for any rake in the wooden pole on which the bracket may be mounted, is announced by the General Electric Company. The malleable iron plate has two cap screws that pass through the upper support and set into clearance holes in the pipe, permitting the pipe to pivot at this point. The bottom of the lower support has a radius with the center swung from the pivoting screw. A clamping nut and washer fit on the end of the pipe, securely clamping it at any desired location.

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A MAGNET WIRE WITH ASBESTOS INSULATION and having a uniform diameter no greater than double cotton-covered magnet wire is announced by the Rockbestos Products Corporation, New Haven, Conn.

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Voltage Control Device for Manufacturers

A HIGH-VOLTAGE RHEOSTATIC control device, called the "Super-Tonatrol," particularly adapted for use by manufacturers, is announced by Electrad, Inc., New York City. Single control units are supplied, but two completely isolated circuits may be controlled by one shaft.

There are two models, A and B, with the same general construction and operating characteristics. The contact is a pure silver multiple type which floats over the resistance element and which, it is claimed, grows smoother with use owing to a microscopic deposit of silver from the contact on the resistance element. This resistance element is fused at high temperature to the surface of a vitreous enameled metal plate. Greater permanence and accuracy of resistance values and more rapid heat dissipation are claimed on account of this feature.

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Interlocking Safety Switch Condulet

A SAFETY SWITCH condulet for use with small portable electric appliances, especially where dust and gases are present, is announced by the Crouse-Hinds Company of Syracuse.

This new condulet, called type FSQ, is furnished complete with a tumbler switch, a vapor-proof cover, a three-pole twist-lock receptacle and a cast feraloy door. The switch is a standard 20-amp., two-pole, single-throw tumbler switch and operates in a vapor-proof compartment. The switch-operating handle interlocks with the receptacle compartment cover, so that the cover cannot be opened and the plug inserted or withdrawn unless the switch is in the off position. The third or grounded terminal of the receptacle and plug are for the connection of a third wire, which can be included in the cable as a grounding wire for the portable device.

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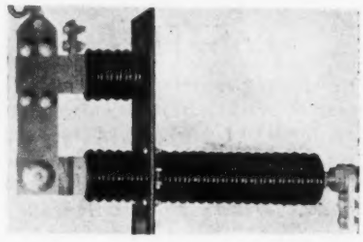
Tongue Type Disconnect

A FORM OF TONGUE TYPE front- and back-connected single-pole hook-stick-operated disconnect has been developed by the Delta-Star Electric Company, Chicago, Ill. The back-connected tube



insulator is sufficiently long to pass through a thick wall and still give sufficient ground clearance.

The switch blade is provided with a positive safety lock operated by the standard hook stick. The back-connected insulator tube is clamped to a steel base so that in case of accidental breakage the tube can be readily withdrawn and a new one inserted without dismounting the entire switch.

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Double-Break Magnetic Starters

A NEWLY DESIGNED MAGNETIC STARTER with duo-break contact which, it is claimed, reduces the arc to 1/20th of its former size is announced by the Trumbull Electric Manufacturing Company, Plainville, Conn. Its maximum horsepower rating is as follows:

Volts A.C.	115	230	460	575
Polyphase	3	5	7½	7½
Single phase	1½	3	5	5

Among features claimed for this starter are its new wiping pressure butt contact with simultaneous double-break action, providing a high interrupting capacity and self-cleaning, self-aligning contacts. No flexible connections are required. A long life for the switch is assured, it is claimed, as a new principle in magnetic construction provides a shock-absorbing arrangement for the elimination of hammer blows on the mechanism as the switch closes.